THERMAL ARRAYCORDER

WR3600

MANUAL NO. WR3600-UM-151

USER'S MANUAL

WESTERN GRAPHTEC

WESTERN GRAPHTEC, INC.
11 Vanderbilt
Irvine, CA 92718-2067
In California (714) 770-6010 / (800) 624-8396
Outside California (800) 854-8385

Preface

The WR3600 Thermal Arraycorder was designed by Graphtec to incorporate a wide variety of advanced recording techniques, ranging from signal input to recording and data transfer.

After unpacking the recorder, read this manual thoroughly before attempting to use the recorder. Do not disassemble any part of the recorder not specifically mentioned in this manual, as this can result not only in irreparable damage to the recorder, but in bodily harm as well. Pay particular attention to the precautions described below.

Before Using this Recorder

After unpacking

After unpacking the recorder, perform a visual inspection and check that all required accessories have been received. Remove the stock section holding fixture (see Fig. 1). If you discover damage to the recorder, contact your sales representative.

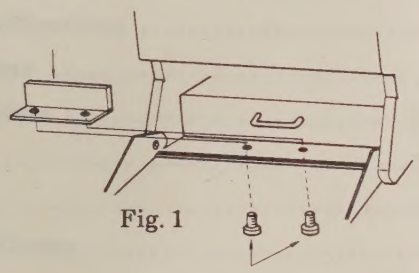


Fig. 1

Installation

This recorder is designed to operate either on a benchtop or mounted in a rack in a normal indoor environment. The following adverse conditions should be avoided.

- Locations subject to excessive dust, dirt, salt and corrosive gases.
- Locations subject to temperature and humidity conditions outside the specified limits.
- Locations subject to direct sunlight.
- Locations subject to excessive vibration and shock.
- Locations susceptible to surge voltages or electromagnetic interference.
- When using the recorder, take care not to block the ventilation holes.

Power Requirements

Power the recorder from a line power source of the nominal voltage ±10% capable of supplying at least 10 A (in the case of 100- and 115-V operation), and one with a means of providing a protective ground connection. Use the accessory power cord provided.

Warning

This recorder has a line voltage selector on its rear to enable operation at voltages other than 100 V. Before attempting any other operation, be sure that this selector is set properly to the line voltage to be used.

Handling Trouble

Should the recorder exhibit abnormal operation, turn the power off immediately and contact your service representative

TABLE OF CONTENTS

1.	BASIC DESCRIPTION	1-1
1.1	General Description	1-1
1.2	Features	1-1
1.3	Configuration	1-2
1.4	Mainframe Specifications	1-3
1.4.1	General Specifications	1-3
1.4.2	Measurement Function Specifications	1-3
1.4.3	Memory Function Specifications	1-8
1.4.4	Trigger Function Specifications	1-8
1.4.5	Analog Input Specifications	1-9
1.4.6	Other Function Specifications	1-9
1.4.7	General Specifications	1-12
1.5	Front Panel Description	1-13
1.5.2	CONTROL Key	1-15
1.5.3	REC MODE Key	1-16
1.5.4	LED DISPLAY Key Group	1-16
1.5.5	FUNCTION Key Group	1-17
1.5.6	TIMING Key Group	1-17
1.5.7	ANNOTATE Key Group	1-17
1.5.8	EVENT Key Group	1-17
1.5.9	CHART SPEED Key Group	1-18
1.5.10	Numeric Key Group	1-18
1.5.11	CURSOR Key Group	1-18
1.5.12	RECALL ZERO Key	1-19
1.5.13	LIST Key	1-19
1.5.14	CHART Switch	1-19
1.5.15	KEY LOCK Switch	1-19
1.5.16	LCD Trimmer	1-19
1.5.17	VERNIER Switch Group	1-20
1.5.18	FORM FEED Key	1-20
1.5.19	RECORD Key Group	1-20
1.5.20	TRACE EXPANSION Key	1-21
1.5.21	POSITION Key Group	1-21
1.6	Secondary Level Function Keys	1-21
1.6.1	DATE/TIME Function	1-22
1.6.2	SAVE ZERO Function	1-22
1.6.3	CHART SPEED Function	1-23

1.6.4 RECORD FORMAT Function 1-24
1.6.5 GRID Function 1-26
1.6.6 ADD EVENT Function 1-26
1.6.7 ANNOTATION Function 1-27
1.6.8 SYSTEM TEST Function 1-29
1.6.9 POLARITY REVERSE Function 1-30
1.6.10 RUN Function 1-31
1.6.11 TRIGGER Function 1-32
1.6.12 MEMORY Function 1-35
1.6.13 DATA SCALE Function 1-36
1.6.14 Other Secondary Level Function Key Descriptions 1-37
1.7 Rear Panel Description 1-38
1.8 PC Board Locations and Functions 1-41
1.8.1 PC Board Locations 1-41
1.8.2 Switch Settings 1-42
1.9 Menu Configuration 1-45
1.9.1 Menu Tree Structure 1-45
1.9.2 Initial Settings 1-46
1.10 Error Alarm 1-46

2. MEASUREMENT AND RECORDING IN THE VARIOUS RECORDING MODES 2-1
2.1 Mounting Recording Paper 2-1
2.1.1 Procedure 2-1
2.2 Connecting and Applying Power 2-5
2.2.1 Precautions 2-5
2.2.2 VOLTAGE SELECTOR Setting 2-5
2.2.3 Power Cord Connection and Powering the Recorder On 2-5
2.2.4 Date and Time Setting Procedure 2-6
2.2.5 Verification of Date and Time 2-6
2.3 Direct Y-T Mode Operation 2-7
2.3.1 Mode Selection 2-7
2.3.2 Recording Format Setting 2-7
2.3.3 Time Marker Setting 2-8
2.3.4 Chart Speed Setting 2-8
2.3.5 Chart Speed Divisor Setting 2-9
2.3.6 Arbitrary Chart Speed Setting 2-9
2.3.7 Grid Setting 2-10
2.3.8 Polarity Reverse Setting 2-11
2.3.9 Run Mode Setting 2-11
2.3.10 Run Time Setting 2-12

2.3.11 Trigger Source Setting 2-13
2.3.12 Trigger Level Setting 2-13
2.3.13 Trigger Function Setting 2-15
2.3.14 Sampling Time Setting 2-16
2.3.15 Memory Output Setting 2-17
2.4 Direct X-Y Mode Operation 2-18
2.4.1 Mode Selection 2-18
2.4.2 Recording Format Setting 2-18
2.4.3 Polarity Reverse Setting 2-20
2.5 Logging Mode Operation 2-21
2.5.1 Mode Selection 2-21
2.5.2 Data Scale Function Setting 2-21
2.6 Memory Y-T Mode Operation (Option) 2-22
2.6.1 Mode Selection 2-22
2.6.2 Recording Format Setting 2-23
2.6.3 Grid Setting 2-24
2.6.4 Polarity Reverse Setting 2-24
2.6.5 Trigger Source Setting 2-25
2.6.6 Trigger Level Setting 2-25
2.6.7 Trigger Function Setting 2-27
2.6.8 Sampling Time Setting 2-28
2.6.9 Memory Output Setting 2-29
2.7 Memory X-Y Mode Operation (Option) 2-30
2.7.1 Mode Selection 2-30
2.7.2 Recording Format Setting 2-30
2.7.3 Polarity Reverse Setting 2-32
2.7.4 Trigger Source Setting 2-33
2.7.5 Trigger Level Setting 2-33
2.7.6 Trigger Function Setting 2-34
2.7.7 Sampling Time Setting 2-36
2.7.8 Memory Output Setting 2-37

3. INTERFACE OPERATION 3-1
3.1 RS-232C Interface 3-1
3.2 Data Transfer 3-8
3.3 Interface Command Table (RS-232C) 3-9
3.4 Detailed Command Descriptions 3-16
3.5 Validity of Commands in Various Operating Modes 3-33
3.6 Typical Command Usage Examples (RS-232C) 3-35
3.7 GPIB Interface 3-42
3.8 Data Transfer 3-45

3.9 Interface Command Table (GPIB) 3-46
3.10 Detailed Command Descriptions 3-52
3.11 Validity of Commands in Various Operating Modes 3-71
3.12 Typical Command Usage Examples (GPIB) 3-73
3.13 Notes on Data Transfer 3-79
Output Data Format 3-83
Format 1 (Binary Data) 3-83
Format 2 (Amplifier Setting Conditions-1) 3-83
Format 3 (Amplifier Setting Conditions-2) 3-84
Format 4 (Status Signals) 3-84
Format 5 (Major Menu Setting Conditions) 3-85
Format 6 (Logging Mode Output Data) 3-86
Recording Example 1 3-87
Recording Example 2 3-88
Recording Example 3 3-89
Recording Example 4 3-90
Recording Example 5 3-91
Recording Example 6 3-92
List Recording Example 1 3-93

4. OUTER VIEWS 4-1

1. BASIC DESCRIPTION

This section gives basic information about the WR3600, such as general description, features, configuration, specifications, names of parts and functions, and menu structure.

Actual operation will be covered in Section 2.

1.1 General Description

The WR3600 is a thermal recorder capable of accommodating signal input units for up to 8 channels. It can perform continuous recording of signals from DC to 10 kHz (in the direct Y-T mode) and can make list recordings (in the direct logging mode).

In both the direct mode and the optional memory mode, a trigger can be used to begin data recording. In addition, signals in the range DC to 10 kHz can be captured in an optional 32-Kword/channel memory (memory mode).

1.2 Features

- Wideband Response and Large Memory Capacity

  The upper measurement frequency limit is 10 kHz in the direct and memory modes, and analog amplifier unit input sections feature single-ended floating-ground configuration and ranges from 500 mV to 10 V full scale, with a resolution of 12 bits.

  A memory of 32 Kwords (1 word = 12 bits) is provided for each channel, easily providing sufficient capacity for most waveform-recording applications (option).

- Continuous Real-Time Recording

  Recording in the direct mode is performed in the same manner as with conventional recorders, with real-time recording and no time delay. In addition, the WR3600 enables the chart speed to be changed during recording, a feature not available on previous models.

- Multifacet Waveform Recording

  The waveform-recording format can be selected as SINGLE (8 channels on 8 frames), DOUBLE (2 channels each overlaid on 4 frames), WIDE (4 channels overlaid each on 2 frames), and list recording in the logging mode, as well as analog X-Y waveform recording.

- Versatile Triggering Capabilities

  The trigger source may be selected as internal, external or manual, and the memory mode can be set to pretriggering, post-triggering, or normal triggering. These versatile triggering functions enable a wide range of measurement and recording applications.

- Simple Condition Settings

  Settings of measurement and recording conditions are made from an interactive menu displayed on an LCD making condition settings extremely simple.

- High-Quality Recording

  An 8-dot/mm thermal dot array is used for thermal recording, providing not only sharp, clear recording of waveforms, but of grid lines, measurement conditions, and scaling as well.

  Data stored in memory can also be output after changing the recording format.

1.3 Configuration

The configuration of the WR3600 is as follows.

Table 1-1

Class	Name	Model	Qty	Remarks
Mainframe	Thermal Arraycorder	WR3600	1	
Accessories	Power cord		1	
	Fuse		1	
	Thermal recording paper	PZ360-B	1	
	Instruction manual	WR3600-UM-151	1	This manual

1.4 Mainframe Specifications

1.4.1 General Specifications

Operating modes	Direct modes: Direct Y-T mode Direct X-Y mode Direct logging Memory modes: Memory save (option) Y-T X-Y Memory out (option) Y-T X-Y
Number of channels	8
Recording method	Thermal recording (black)
Recording head	Thermal dot array (8 dots/mm)
Recording width	Approx. 368 mm (184 mm×2)
Recording paper	PZ360-B (Z-fold, width: 397 mm, total length: 100 m) PZ361-B (Z-fold, width: 397 mm, total length: 200 m) PZ360-B (roll paper, width: 397 mm, total length: 100 m)
Recording paper feed pitch	0.125 mm/8 pulses (1 mm/64 pulses)
Recording frame types	Data recording (simultaneous recording with list is possible), list recording (list of setting conditions) and paper feed (page sensing performed for Z-fold paper) (Refer to (a) to (f) in Section 1.4.2 for details.)
Recording accuracy	Amplitude Y: ±0.2% of rdg. ±0.2 of full scale ±1 dot (0.125 mm) Chart feed accuracy T: ±0.5% ±0.25 mm (at 25 ±5°C) X-direction accuracy X: ±1.0% ±0.25 mm (at 25 ±5°C)

1.4.2 Measurement Function Specifications

(a) Direct Y-T Mode

Recording formats	Single, double, wide

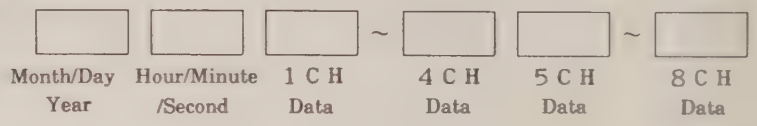
Combinations of recorded data	Single: 8-frame recording of CH1 thru CH8 separately from the left. Double: Overlaid recordings of CH1 & CH2, CH3 & CH4, CH5 & CH6, and CH7 & CH8 from the left. Wide: Overlaid recordings of CH1 thru CH4 and CH5 thru CH8 on two frames.
Signal recording width	Single: 40 mm (320 dots) Double: 80 mm (640 dots) Wide: 160 mm (1280 dots)
Recording paper feed speeds	Speed value directly switch settable. 1, 2, 5, 10, 20, 50, 100 and 200 mm/s or min. and 1/10, 1/60 or 1/100 of these speeds. Switching of any two chart speeds. Arbitrary 4-digit setting in the range 0.001 to 200.0 mm/s or min or 500 mm/s or min can be made.
Time-axis resolution	64 dots/mm max. 8/2.5 dots/mm 500 mm/s 8 dots/mm 200 mm/s or slower 16 dots/mm 100 mm/s or slower 32 dots/mm 50 mm/s or slower 64 dots/mm 25mm/s or slower
Time-axis line response	1600 lines/s
Recording length	Continuous
Interpolation function	Linear interpolation
Sampling interval	80 kHz
Frequency response	DC to 10 kHz (−3 dB)
Grids (scale line printing)	Seven types selectable. Time-axis × amplitude (1) 10×10 mm (2) 10 fine grid lines printed at 1-mm intervals within each 10×10 mm grid (3) 5×5 mm (4) 5 fine grid lines printed at 1-mm intervals within each 5×5 mm grid (5) 5×4 mm (6) 4 fine grid lines every 1 mm along time axis with 5×4 mm lines (7) No grid lines
Event marker	2 events (front panel/external remote) Events between 8 channels (EXT remote, option)

Timing marker	0.1, 1, 10 marks/s or min
Printing functions	(1) System annotation Date, time, chart speed, and time scale are printed. **Note:** The date and time are selected as the internal real-time clock or a time code (IRIG-A, B, E, NASA-36, optional). (2) Channel annotation Front panel key or external host controlled 128 characters/channel on 8 channels can be printed. (3) Page annotation Front panel key or external host control 40 characters × 80 lines printable (4) Print repeat Repeated printing of annotation is possible at a set interval. Every 100, 200, 300, 400, or 500 mm, every page, and no printing. **Note:** System annotation can be combined with channel annotation or page annotation. Channel annotation and page annotation can be switched from either the front panel or from an external host computer.
Additional functions	(1) RUN mode setting Trigger start Trigger speed change Trigger memory mode (2) RUN time setting Time setting: 1 s to 59 min 59 s Length setting: 1 to 9999 mm
Additional recording	Scaling values, position marks, channel numbers and setting conditions can be listed for each channel.
(b) Direct X-Y Mode	
Axis specifications	Xa, Ya1 to Ya3 (channels 1 to 4) and Xb, Yb1 to Yb3 (channels 5 to 8) can be set. (Ya1 to Ya 3 and Yb1 to Yb3 can also be specified as off.)
Signal recording width	150 mm (1200 dots) for both X and Y axes
Recording length	Continuous
Interpolation function	Linear interpolation
Sampling interval	Approx. 80 Hz

Frequency response	DC to 10 Hz (−3 dB)
Grid	150 mm divided into 100 divisions (10 fine grid lines printed at 1.5 mm intervals every 15 mm.)
Other recorded items	Scale values, position marks, axis type and setting conditions are listed for each channel.

(c) Logging Mode

Recording format

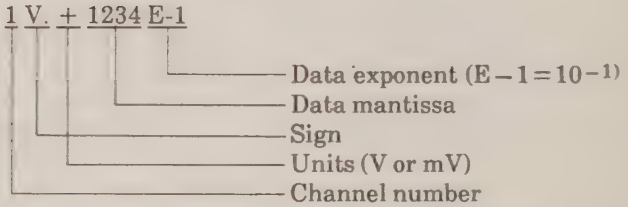


Data recorded

Month/day/year:
01 to 12/01 to 31/(Last two digits of year only)

Hour/minute/second:
00 to 23/00 to 59/00 to 59

Data for each channel:
See example below.



Additional function	Linear scaling (± full scale is scaled to −99999 to +99999 with no units.)
Recording interval	1, 10 s, or min.
Other recorded items	Setting condition listing

(d) Memory Y-T Mode (option)

Recording formats	Single, double, wide
Combinations of recorded data	Single: 8 frames recorded separately for CH1 thru CH8 Double: CH1 & 2, CH3 & 4, CH5 & 6, and CH7 & 8 are each overlaid on four frames. Wide: CH1 thru CH4 and CH5 thru CH8 are overlaid on two frames for recording.
Signal recording width	Single: 40 mm (320 dots) Double: 80 mm (640 dots) Wide: 160 mm (1280 dots)

Time-axis resolution	8, 16, or 32 dots/mm (depends upon scaling factor setting value)
Recording time	Sampling interval memory size (number of points)
Recording length	Memory size × scaling factor ÷ 8 (mm) ((Number of points) × (1/1, 1/2, 1/4, 1/8) ÷ 8) (mm) **Note:** If the output area is specified after the memory size is set, this will be the number of points in the output area.
Recording compression function	The scaling factor (1/1, 1/2, 1/4, 1/8) is set to provide a compressed recording output.
Partial recording output	The output area is selected to provide recording output of only the desired portion of data (settable as 0 to 100% of the memory size from the trigger point in 1% steps. (Example: 50 to 75%))
Interpolation function	Linear interpolation
Grids	Seven types selectable. Time-axis × amplitude (1) 10 × 10 mm (2) 10 fine grid lines printed at 1-mm intervals within each 10 × 10 mm grid (3) 5 × 5 mm (4) 5 fine grid lines printed at 1-mm intervals within each 5 × 5 mm grid (5) 5 × 4 mm (6) 4 fine grid lines every 1 mm along time axis with 5 × 4 mm lines (7) No grid lines
Other recorded items	Scale values, position marks, channel numbers, trigger comments and setting conditions listed for each channel.

(e) Memory X-Y Mode (option)

Axis specifications	Xa, Ya1 to Ya3 (channels 1 to 4) and Xb, Yb1 to Yb3 (channels 5 to 8) can be set. (Ya1 to Ya 3 and Yb1 to Yb3 can also be specified as off.)
Signal recording width	150 mm (1200 dots) for both X and Y axes
Recording time	Sampling interval × memory size (number of points)
Partial recording output	The output area is selected to provide recording output of only the desired portion of data (settable as 0 to 100% of the memory size from the trigger point in 1% steps. (Example: 50 to 75%))

Interpolation function	Linear interpolation
Grid	150 mm divided into 100 divisions (10 fine grid lines printed at 1.5 mm intervals every 15 mm.)
Other recorded items	Scale values, position marks, axis type and setting conditions are listed for each channel.

(f) List Recording

Recorded items	Analog input setting conditions for each channel (analog input conditions) and mainframe setting conditions (system conditions) are recorded as a list.
System conditions	Date/time, interface control mode, operating mode, recording format, chart speed setting, timing marker, system annotation format, annotation print repeat, external event, memory conditions, trigger conditions, RUN mode, RUN time setting conditions.
Analog input conditions	Input, on/off, range, input polarity status, position setting conditions printed out.

1.4.3 Memory Function Specifications (Apply for Memory Save and Direct Y-T RUN Mode, Optional)

Sampling interval	10, 20, 50, 100, 200, 500 µs 1, 2, 5, 10, 20, 50, 100, 200, 500 ms and external sampling clock
Memory capacity	0.25, 0.5, 1, 2, 4, 8, 16, 32 Kwords/channel
Memory output area	0 to 100% of specified memory capacity (settable in 1% steps)

1.4.4 Trigger Function Specifications

Trigger source	Manual, internal, external
Trigger conditions	Manual: Start button Internal: Triggering on conditions set by a menu External: Triggering on a TTL low-level or ground input
Trigger channel	Selectable as any channel of channels 1 thru 8
Trigger slope	Positive-going or negative-going
Trigger level	±100% (± full scale), settable in 1% steps
Trigger level accuracy	±4%
Trigger functions	Normal, pretriggering, post-triggering
Trigger offset	12.5%, 25%, 50%, 100%

1.4.5 Analog Input Specifications

Number of channels	8
Input configuration	Single-ended, floating ground
Input ranges	0.5, 1, 2.5, 5, 10 V full scale **Note:** The input processing range is double the above (i.e., ±0.5, ±1, ±2.5, ±5, ±10 V).
Zero-point setting	Settable within 100% of input full scale. Position step: Position can be moved in units of the minimum step on the setting grid. Fine position: Fine adjustment
Input waveform monitor	Input signals monitored by LEDs on operating panel (depends upon specified format). Single: 21 points full scale×8 channels displayed Double: 41 points full scale×8 channels displayed (2 channels of 41 points full scale) Wide: 81 points full scale×8 channels displayed (4 channels of 81 points full scale)
Channel gain vernier	Approx. ±15% adjustment of the input range sensitivity on the mainframe panel using a potentiometer.

1.4.6 Other Function Specifications

Operation

Secondary level keys: Interactive with LCD (mainframe setting conditions)

Primary level keys: Mainframe switches can be used to directly set the following function conditions.

(1) Interface mode: LOCAL/REMOTE (TTL)/REMOTE interface
(2) Recording mode: DIRECT/LOGGING/MEMORY SAVE (option)/MEMORY OUT (option)
(3) Time marker: 0.1, 1, 10 s or min.
(4) Annotation selection: PAGE/CH
(5) Event marker: LEFT SIDE/RIGHT SIDE
(6) Chart speed
(7) Start/stop

LED display: 7-segment LED display of the following conditions is possible.

(1) Date or time
(2) Chart speed setting value
(3) Input sensitivity
(4) Arbitrary chart speed condition

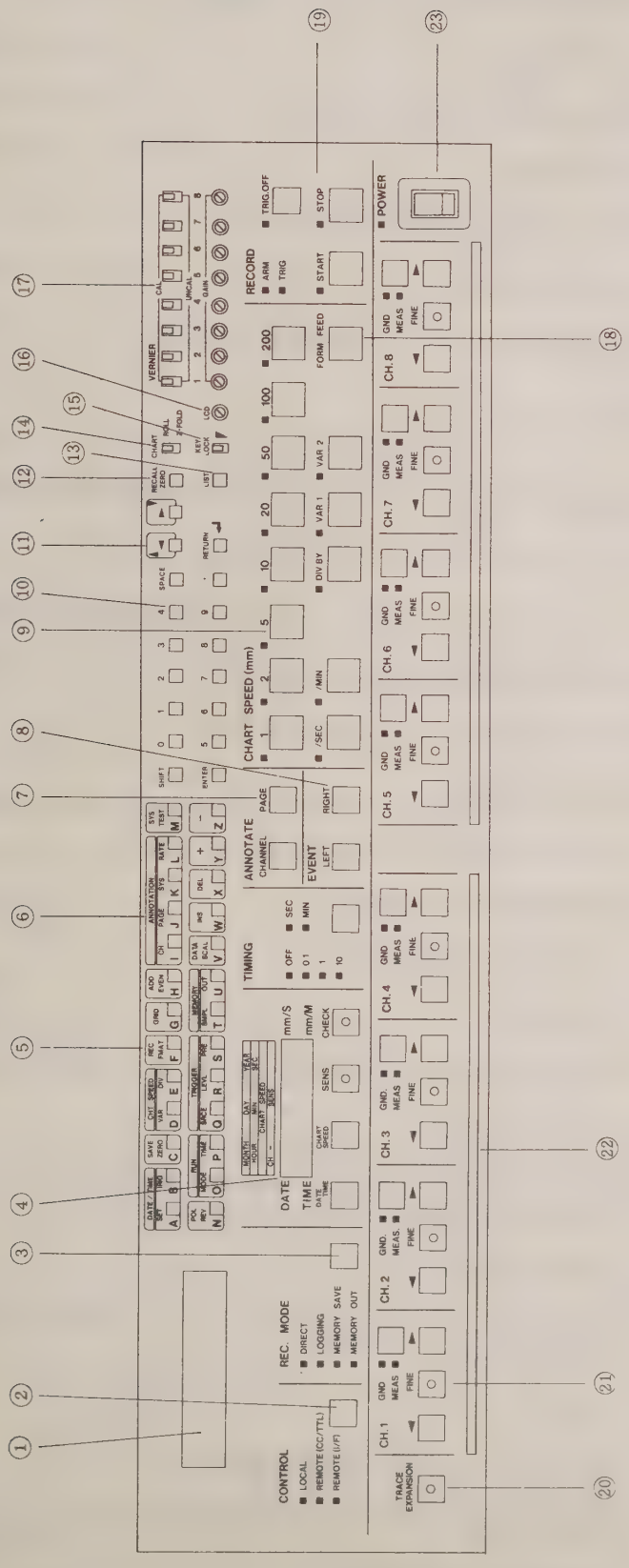
Clock function	Display and recording of date and time using an internal clock.
Battery backup	Clock and all operating mode setting conditions are backed up by a built-in battery (approx. 1 month on a full charge).
Power-on start function	Restart of operating conditions in effect when power was switched off.
Reprint function	Data captured with memory SAVE can be reprinted or output with a changed output format, as long as power is not removed or data is not captured once again (option).
Remote function	Start/stop, MEAS OFF (CH1 thru CH8), EVENT (RIGHT/LEFT), paper feed and, for memory mode, EXT. TRIG, EXT. SAMPLE CLOCK
Interface type	RS-232C or GPIB
Interface functions	Type of data output from mainframe (1) Mainframe main setting conditions (2) Mainframe operating status (3) Data captured in memory mode (4) Date and time and channel data in the logging mode Types of data transferred from the host computer (1) Channel annotation comment input (2) Page annotation comment input (3) Main setting condition input (e.g., chart speed and timing marker settings) Types of control of the mainframe (1) Start/stop (2) List output (3) Paper feed (4) Analog input on/off (CH1 thru CH8) (5) Event marker on/off (RIGHT/LEFT)
Digitized input (option)	This is an optional function that uses the GPIB interface to accept a digital input from an external computer and plot waveforms on up to 32 channels.
Interface type	GPIB
Number of recording channels	8, 12, 16, or 32
Recording amplitude	10 mm (32 ch), 20 mm (16 ch), 25 mm (12 ch), 40 mm (8 ch)
Recording timing	Synchronized chart feed (Chart feed speed is synchronized to data input) Continuous chart feed (recording chart speed is set without regard to the data input speed)

Recording speed	For SCF: 0.125 mm feed for each DI command (digital input data). DI command is 400/s max. (Except 200/s max for 32-channel recording) For CCF: 0.01 to 50 mm/s (20 mm max. in 32-channel mode)
Numerical input data	Binary code in the range 0 to FFF_{16} in the sequence Hi byte, followed by Low byte
Scale value	0 FFF_{16} at top-scale edge and 000_{16} at bottom scale edge.

1.4.7 General Specifications

Operating environment	0 to 40°C, 35 to 85% humidity
Power requirements	100, 115, 200, 220, or 240 VAC, selectable ±10%, 50/60 Hz
Power consumption	200 VA ave. (800 VA maximum when executing envelope printing on 8 channels)
Weight	Approx. 32 kg
Outer dimensions	Approx. 439(W)×264(H)×447(D) mm

1.5 Front Panel Description



① LCD

Liquid crystal display used to display menus for operating condition settings and display of operational status.

② CONTROL key

Used to select recorder operations.

③ REC.MODE key

Used to select operating modes.

④ LED DISPLAY key group

LED display indicates operating conditions and keys that select display modes.

⑤ FUNCTION key group

Keys used to set operating conditions for various operating modes and select operating menus.

⑥ TIMING key

Used to select the marking time interval for the time marker.

⑦ ANNOTATE key group

Used to select annotation (channel/page).

⑧ EVENT key group

Used to operate event marking (left and right).

⑨ CHART SPEED key group

Used to select the chart speed.

⑩ Numeric keys

Used to select values that set items in menus and includes an ENTER key.

⑪ CURSOR key group

Includes the cursor keys that move the cursor to select setting values from each menu or other menu items, and the RETURN key.

⑫ RECALL ZERO key

Used to return to the ZERO point stored as the ZERO in the backup memory of the mainframe.

⑭ LIST key

Used to print recorder setting conditions.

⑮ CHART switch

Used to select chart paper type.

⑯ KEY LOCK switch

Used to prevent misoperation.

⑰ LCD trimmer

Used to adjust the contrast of the liquid crystal display.

⑱ VERNIER switch group

Input sensitivity switches and adjustment trimmers.

⑲ FORM FEED key

Used to feed the chart paper 1 page.

⑳ RECORD key group

Recording start/stop and on/off selection keys.

㉑ TRACE EXPANSION key

Used to switch the recording width during recording.

㉒ POSITION key group

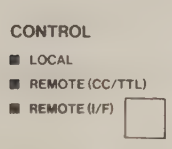
Position keys used to change the zero-point for each channel and keys used to turn measurement on and off for each channel.

㉓ Bar graph

LED bar graph display indicating the recording position for each channel.

㉔ POWER switch

1.5.2 CONTROL Key



This key is used to select recorder operations. Each time it is pressed, the operating mode changes, with the LED corresponding to the mode lighting.

① LOCAL: In this mode, operating panel switches are operative.

② REMOTE (CC/TTL): In this mode, the following control is performed by remote signals.

START/STOP
EVENT (RIGHT, LEFT)
FORM FEED
MEAS

In the REMOTE mode, the panel switches related to the above functions do not operate.

③ REMOTE (I/F): In this mode, the interface (RS-232C or GPIB) can be used for operation. When using the WR3600 in this mode, read the interface manual thoroughly.

1.5.3 REC MODE Key

This key selects the operating mode. Each time it is pressed, the operating mode changes and the LED associated with the mode lights.

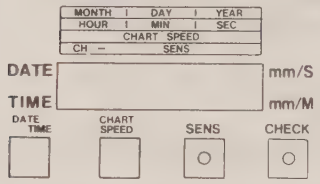
① DIRECT: In this mode, direct Y-T and direct X-Y recording are possible.

② LOGGING: In this mode, logging recording is possible.

③ MEMORY SAVE: In this mode, memory storage is possible (option).

④ MEMORY OUT: In this mode, recording is possible of data stored in the mainframe memory (option).

1.5.4 LED DISPLAY Key Group



① DATE TIME key: Used to display the date or time.

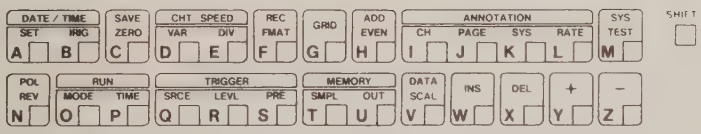
② CHART SPEED key: Used to display the set chart speed.

③ SENS key: Used to display the set input sensitivity. Each time the switch is pressed, the displayed channel changes.

④ CHECK key: Used to display the preset contents of memory. Each time the key is pressed, the contents change to the sequence given below.

0 ANNOTATION (Displayed as CH or PA)
↓
3 VAR. 1 (Variable chart speed 1 displayed)
↓
2 VAR. 2 (Variable chart speed 2 displayed)
↓
1 DIV (Chart speed divisor displayed)
→ 0 ANNOTATION

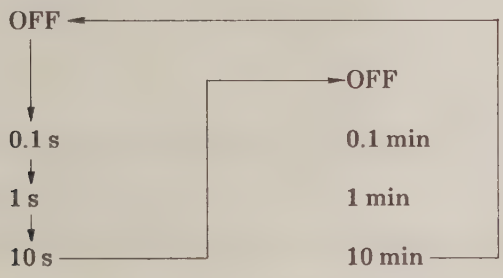
1.5.5 FUNCTION Key Group



These keys are used to set the operating mode conditions. In normal use, they serve to input letters of the alphabet. When using secondary level function keys (i.e., keys pressed simultaneously with the SHIFT key), read the section on secondary level function keys thoroughly.

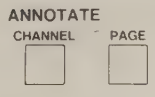
1.5.6 TIMING Key

This key is used to select the marking time interval for the time marker. Each time the key is pressed, the marking time interval changes to the sequence shown below.



The LED corresponding to the currently selected setting lights.

1.5.7 ANNOTATE Key Group

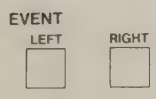


These keys select annotation.

① CHANNEL key: Selects channel annotation.

② PAGE key: Selects page annotation.

1.5.8 EVENT Key Group



These keys operate the event marker (left/right).

① LEFT key: Operates the left event marker.

② RIGHT key: Operates the right event marker.

1.5.9 CHART SPEED Key Group

① Numeric keys: Used to select the chart speed value.

② /SEC key: Used to select units per second for the chart speed.

③ /MIN key: Used to select units per minute for the chart speed.

④ DIV. BY key: Used to select the division ratio for the above-described chart speed. When using, it is necessary to set the division ratio (1/10, 1/60, 1/100) using function keys.

⑤ VAR. 1 and VAR. 2 keys: Used to select an arbitrary chart speed. When using these keys, it is necessary to select arbitrary chart speed using the function keys.

1.5.10 Numeric Key Group

① Numeric keys: Used to select values and setting items from menus.

② SPACE key: Used to set spaces in menus.

③ · key: Used to enter a decimal point when setting menu values.

④ ENTER key: Used to change the menu item or set a value.

1.5.11 CURSOR Key Group

① CURSOR keys: Used to select setting values in menus and to select menu items.

② RETURN key: Used to establish the setting screen within a menu.

1.5.12 RECALL ZERO Key

Even if the position keys are used to change the recording position for 0-V input, the RECALL ZERO key can be pressed to reset the recording position for the ZERO-point recording position for the 0-V input stored in backed up memory. However, it is necessary to save the 0-V input recording position into backed up memory using the SAVE ZERO function key.

1.5.13 LIST Key

This key is used to print setting conditions. For roll-type chart paper, when this key is pressed, the printing of a list starts immediately. For Z-fold chart paper, when the key is pressed the list printing starts after feeding the chart paper to the top of the next page.

1.5.14 CHART Switch

This switch is used to select the type of chart paper (roll or Z-fold).

1.5.15 KEY LOCK Switch

This switch is used to prevent misoperation. When slid in the direction of the arrow, the Arraycorder goes into the key-lock condition, and all front-panel keys with the exception of the POWER switch and Vernier switches and trimmers become inoperative.

1.5.16 LCD Trimmer

This trimmer is used to adjust the LCD contrast. Turning it clockwise increases contrast.

1.5.17 VERNIER Switch Group

① VERNIER switches: When a switch is set to the UNCAL position, it is possible to fine-adjust the input sensitivity for the corresponding channel.

② GAIN trimmers: The GAIN trimmer for a channel for which the VERNIER switch has been set to the UNCAL position can be turned to adjust the input sensitivity on that channel by approximately ±15%. Turning the trimmer clockwise increases sensitivity.

1.5.18 FORM FEED Key

This key performs a chart paper page feed. For Z-fold paper, when the key is pressed, the chart paper moves to the top of the next page. For roll paper, when the key is pressed, the chart paper feeds approximately 300 mm.

1.5.19 RECORD Key Group

① START key: Starts recording

② STOP key: Stops recording

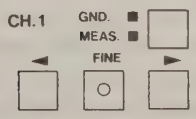
③ TRIG. OFF key: Turns trigger operation on and off. When the TRIG. OFF LED is lighted, triggered operation is disabled.

1.5.20 TRACE EXPANSION Key

This key is used to change the recording format during recording. Each time the key is pressed, the format changes through the following sequence.

SINGLE → DOUBLE → WIDE → SINGLE

1.5.21 POSITION Key Group



① ◄ ► keys: Move the recording position for 0-V input for each channel. The position can be moved within ±full scale with respect to the input sensitivity.

② FINE key: Pressing the FINE key enables fine adjustment of position.

③ GND./MEAS. key: Enables selection of MEAS/GND/UNREQUIRED for each channel. Each time the key is pressed, the mode changes through the following sequence.

MEAS. (MEAS. LED lights) → GND. (GND. LED lights) → UNREQUIRED (LED extinguished) → MEAS.

1.6 Secondary Level Function Keys

Second-level function keys are accessed with the WR3600 in the stopped condition by pressing a function key while holding the SHIFT (blue) key. When this is done, a comment is displayed on the LCD and the selected function is set. Settings are made by using the CURSOR keys to select an item or by inputting a value by means of the numeric keys and the decimal-point key, followed by the ENTER key. For channel or page annotation, an annotation character string to be printed out is input as alphanumeric characters. (Annotation consists of several items of input, and it is slightly different than other input. Annotation setting should be made after reading this manual thoroughly.)

1.6.1 DATE/TIME Function

The DATE/TIME function consists of date and time settings and the IRIG function when the optional time code input unit (IRIG-A,B, and E and NASA-36, with switchable AC carrier input and DC code input) is installed.

- Date and Time Setting

If the SHIFT key and DATE/TIME set (A) key are pressed simultaneously, the date and time can be set.

```
Date   03:27:88   → Month:Day:Year
Time   19:00:00   → Hour:Minute:Second
```

The blinking cursor indicates the field that can be set by numerical input. Use the CURSOR keys to move the cursor to the field to be changed, input the desired value using the numeric keys, and then press the ENTER key to make the setting.

Note

Month, day, hour, and minute/second settings of 13, 32, 24, and 60 or greater are not allowed. Since the WR3600 has a battery backup function, re-setting is not required for up to one month with power removed. If the WR3600 is left with power off for more than one month, the battery can be fully charged by applying power for 48 hours or longer.

- Time code (IRIG)

By pressing the SHIFT key and DATE/TIME IRIG (B) key simultaneously, the setting menu is displayed.

```
Clock?
1. Internal
```

→ 1. Internal: internal real time
→ 2. Time code: time code input

Use the CURSOR keys to display the desired item and either press the ENTER key or use the numeric 1 and 2 keys to make the setting. For numeric input, the ENTER key need not be pressed to make the setting.

Note

For WR3600 Arraycorders not fitted with the optional time-code input unit, always input 1 (Internal).

1.6.2 SAVE ZERO Function

SAVE ZERO is a function used to set storage of the recording position for 0-V input into battery backed up memory within the WR3600. When SAVE ZERO is executed, even after the 0-V input recording position is changed using the position keys for CH1 through CH8, the RECALL ZERO key can be used to reset the original 0-V input positions.

SAVE ZERO Setting

If the SHIFT key and the SAVE ZERO (C) key are pressed simultaneously, the comment shown below is displayed on the LCD. Next, press the ENTER key to store the current 0-V input recording position in backup memory in the WR3600.

```
Save Offset Posi?
Push ENTER Key
```

1.6.3 CHART SPEED Function

The CHART SPEED function enables setting of an arbitrary speed in the direct Y-T recording mode, (VAR: variable speed) and setting of the chart speed divisor (DIV. BY). If this function is evoked, the CHART SPEED key group of the primary-level keys can be selected to achieve an arbitrarily set chart speed. The arbitrary chart speed is used for recording using the VAR. 1 or VAR. 2 keys.

The chart speed divisor (DIV. BY) is a function that sets the 1 to 200 (1, 2, 5, 10, 20, 50, 100, 200) of the primary-level key CHART SPEED key group to 1/n. The divisor n can be set by means of 1/1, 1/10, 1/60, and 1/100. Therefore, in addition to the 1 to 200 mm/s or min of the CHART SPEED group, the DIV. BY key can be selected to set the following chart speeds.

1 to 200 mm/s or min *1/n

- Arbitrary Chart Speed Setting

  Select VAR. 1 or VAR. 2 of the primary-level CHART SPEED key group and press the SHIFT Key and CHART SPEED VAR (D key) simultaneously to select the VAR. 1 or VAR. 2 arbitrary chart speed setting function.

  If a primary-level key other than VAR. 1 or VAR. 2 is set (1 to 200) the following display appears.

```
Please Select
Var1 or Var2
```

  In this case, when VAR. 1 or VAR. 2 is selected from the primary-level key CHART SPEED key group, the arbitrary chart speed setting function is selected. If VAR. 1 is selected, the following display appears. If VAR. 2 is selected, the V. 1 in the display will be V. 2.

```
Chart Speed V. 1
    000. 1/SEC
```

  The blinking cursor indicates the part of the display that can be input. Use the numeric keys to perform input, and specify the time units when the 1 is blinking as seconds by pressing S or minutes by pressing the M key. The input range is 000.1 mm/s or min to 200.0 mm/s or min, set in 000.1 steps. Also, a special setting of 500.0/s or min can be input. When setting is completed, press ENTER.

  Note

  When making settings, always position the decimal point between the third and fourth digits. Also, always input leading zeros using the 0 key so that

the field to the left of the decimal point consists of three digits. When making both VAR. 1 and VAR. 2 settings, perform the same procedure twice.

1.6.4 RECORD FORMAT Function

The RECORD FORMAT function includes Y-T recording/X-Y recording settings, Y-T recording width (single, double wide) settings, input channel settings for X-Y recording X axis and Y axis (Y1, Y2, Y3), and whether or not a list is required for output at the end of recording. When the recording format is set to X-Y, recording is divided into two groups of channels, 1 to 4 and 5 to 8.

- Recording Format Setting

When the SHIFT and RECFMAT (F) keys are pressed simultaneously, the recording format setting menu is displayed.

```
Record Format
1. Y-T   2. X-Y
```

Use the cursor keys to move the blinking cursor to the desired item and press the ENTER key to make the setting.

- Recording Width Setting (Y-T Recording)

When the recording format is set to Y-T, the recording width setting menu is displayed.

```
Record Y-T
1. Single
```

→1. Single (40 mm wide)
2. Double (80 mm wide)
3. Wide (160 mm wide)

Use the cursor keys to display the desired item and either press the ENTER key to make the setting or make the setting by pressing numeric keys 1 through 3. For numeric input, the ENTER key need not be pressed to make the setting. For recording, refer to recording example 1.

- X-Axis Setting (X-Y Recording)

If the recording format is set to X-Y, the X-axis setting menu is displayed.

```
Record X-Y (1~4)
X=1  2  3  4  ch
```

The channel of channels 1 through 4 corresponding to the X axis is set. This can be done using the CURSOR keys or the numeric keys.

- Y1-Axis Setting (X-Y Recording)

When the X-axis setting is completed, the Y1-axis setting menu is displayed.

```
Record X-Y (1~4)
Y1=2  3  4
```

Note

The channel specified as the X axis is not displayed in the Y-axis setting menu.

In the above example, the channel of channels 2 through 4 corresponding to the Y1 axis is set. The setting can be made by the CURSOR keys or by the numeric keys.

- Y2-Axis Setting (X-Y Recording)

When the Y1-axis setting is completed, the Y2-axis setting menu is displayed. In this menu, the OFF setting can also be made. If an axis that is not required is set to OFF, recording is inhibited.

```
Record  X-Y (1~4)
 Y2=2  3  4  OFF
```

Note
When the OFF SETTING is made, the cursor keys only are operative i.e., numeric entry is not possible.

- Y3-Axis Setting (X-Y Recording)

When the Y2-axis setting is complete, the Y3-axis setting menu is displayed.

```
Record  X-Y (1~4)
Y3=2  3  4  OFF
```

Note
When the OFF SETTING is made, the cursor keys only are operative i.e., numeric entry is not possible.

For recording, refer to recording example 2.

Note

If the recording format is set to X-Y, recording is divided into two groups of channels 1 through 4 and channels 5 through 8. After making axis settings of channels 1 through 4, the group of channels 5 through 8 must be set. The method of setting the axis for these channels is the same as for channels 1 through 4.

- List Printing Setting

This setting establishes whether or not a list should be printed when recording is stopped.

```
   LIST  Print?
   1. Yes    2. No
```

The setting may be made by using the cursor keys or the numeric keys.

If the list print is set to Yes, the list will be started as follows.

① For roll paper: List printing is started immediately when the recording is stopped.

② Z-fold paper: After recording stops, list printing is performed after a page feed.

For list recording, refer to the list recording example 1.

The above completes the RECORD FORMAT function settings.

1.6.5 GRID Function

The GRID function includes the GRID format setting and the Fine Grid setting. However, the GRID function setting is valid only when the RECORD FORMAT function is set to Y-T recording, and is not valid for X-Y recording.

- GRID Format Setting

  If the SHIFT key and GRID (G) key are pressed simultaneously, the GRID format setting menu is displayed.

```
Grid Format?
1 OFF
```

→ 1: OFF

2: 10 mm × 10 mm

3: 5 mm × 5 mm

4: 5 mm × 4 mm

  Use the cursor keys or the numeric keys to make the setting. If the grid format setting is selected as OFF, the GRID function setting is terminated.

- Fine Grid Setting

  If 2 to 4 are selected from the grid format setting menu, the fine grid setting menu is displayed.

```
Fine Grid?
1. Yes  2. No
```

  Settings can be made with the cursor keys or with the numeric keys. If the fine grid "Yes" setting is made, fine grids with an interval of 1 mm are printed between other grid lines. This completes the description of the GRID function. For grid formats, see recording example 3.

1.6.6 ADD EVENT Function (Option)

Using the ADD EVENT function, it is possible to enable or disable events on each of channels 1 thru 8. However, the ADD EVENT function setting is operative only in the direct Y-T recording mode, and event recording is disabled in any other recording mode (for example, X-Y recording and memory Y-T recording).

- Channel Event Setting

  If the SHIFT key is pressed simultaneously with the ADD EVENT (H) key, the channel event setting menu is displayed.

```
CH. EVENT 1
1. OFF  2. Ext
```

  Settings are made starting with channel 1 and ending with channel 8. The setting is made by means of cursor keys, and for channels for which the channel event is "Ext", an event will be recorded at the side of the recording area for Y-T recording. Event recording input is made from the Ext remote board.

1.6.7 ANNOTATION Function

The ANNOTATION function includes the channel annotation setting, the page annotation setting, the system annotation setting and the print repeat setting.

However, the ANNOTATION function setting is valid only in the direct Y-T mode and annotation is not recorded for the other modes (for example, X-Y recording and memory Y-T recording).

For details on annotation recording, refer to the recording example 4.

- Channel Annotation Setting

  If the SHIFT key is pressed simultaneously with the CH (I) key, the channel annotation setting menu is displayed.

  ```
  CH. 1  CLUMN  001
  ```

  The value at the top right is the sequence number for input characters and the maximum number of characters is 128. Channel annotation input is made using alphabet keys or numeric keys (up to 128 characters), and is terminated by pressing the RETURN key, at which point the channel annotation setting screen appears for the next channel. If instead of the RETURN key, the ENTER key is pressed, the channel annotation setting is terminated and the next channel annotation setting screen does not appear. When channel annotation has been set, the set annotation will be recorded for each channel at the side of the recording area in the direct Y-T recording mode.

  Notes

  1. When the RETURN key is pressed when making the channel annotation setting, characters to the right of the blinking cursor on the LCD screen will be ignored. Particular care with respect to this is required when the INS or DEL key has been used.

  2. Switching of channel annotation and page annotation during recording can be effected by pressing the CHANNEL and PAGE keys, respectively. If channel annotation is not recorded, press the CHANNEL key.

  3. Channel annotation will not be recorded unless the print repeat setting described later in this document has been made.

  4. If the up/left or down/right key is pressed simultaneously with the SHIFT key, the setting channel is changed.

- Page Annotation Setting

  If the SHIFT key is pressed simultaneously with the PAGE (J) key, the page annotation setting menu is displayed.

  ```
  LINE  01  ROW  01
  ```

  LINE: Indicates the display line number (maximum 40)

ROW: Indicates the displayed character number (maximum 80)

Page annotation input is made by alphabet and numeric keys (maximum of 40 lines by 80 characters) and is terminated by the RETURN key, after which the annotation setting menu for the next line appears. If instead of RETURN key the ENTER key is pressed, the annotation setting is terminated. When the page annotation setting has been made, the set annotation is recorded in the recording area for channels 1 through 4 in the direct Y-T recording mode.

Notes

1. When the RETURN key is pressed when making the page annotation setting, characters to the right of the blinking cursor on the LCD screen will be ignored. Particular care with respect to this is required when the INS or DEL key has been used.

2. Switching of channel annotation and page annotation during recording can be effected by pressing the CHANNEL and PAGE keys, respectively. If channel annotation is not recorded, press the CHANNEL key.

3. Page annotation will not be recorded unless the print repeat setting described later in this document has been made.

4. If the up/left or down/right key is pressed simultaneously with SHIFT key, the setting channel is changed.

- System Annotation Setting

If the SHIFT key is pressed simultaneously with the SYS (K) key, the system annotation setting menu is displayed. The setting can be made by using the cursor keys or numeric keys.

```
MODIFY FORMAT?
1. YES   2. NO
```

This screen is used to establish whether or not the system format is to be changed. If YES is selected, the modification setting screen appears. If NO is selected, the system annotation setting is terminated.

The system format modification screen changes in the following sequence.

```
PRINT DATA?
1. YES   2. NO
```
Date printing required/not required

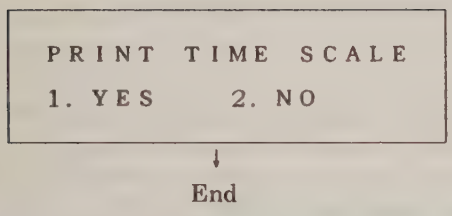
↓

```
PRINT TIME?
1. YES   2. NO
```
Time printing required/not required

↓

```
PRINT SPEED?
1. YES   2. NO
```
Paper feed speed printing required/not required

↓



Time scale printing required/not required

Note

System annotation will not be recorded unless the print repeat setting described below has been made.

- Print Repeat Setting

If the SHIFT key is pressed simultaneously with the RATE (L) key, the print repeat setting menu is displayed, and setting is possible of the annotation repetition interval.

→

1. No
2. Each page
3. 100 mm
4. 200 mm
5. 300 mm
6. 400 mm
7. 500 mm

Setting is possible using the cursor keys or the numeric keys. If NO is selected, the annotation is not recorded.

Note

If the number of characters set as the annotation is greater than the print repeat interval, the print repeat interval will be automatically changed after the start of recording so that the entire annotation fits.

1.6.8 SYSTEM TEST Function

The SYSTEM TEST function includes the 0 Point Check, Panel Check, and RAM initialization modes.

- SYSTEM TEST setting

If the SHIFT key is pressed with the SYSTEST (M) key, the system test setting menu is displayed.

→

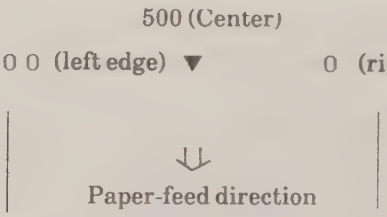
1. 0 Point Check
2. Panel Check
3. RAM Initialization

The setting can be made by using either cursor keys or numeric keys.

The following is a description of the system test itself.

1. 0 Point Check

   The 8-segment LED will indicate the specified channel number and the zero-point position. The zero-point position display is indicated in the range 0 to 1000, and the relationship between the recording position and the displayed value is as follows. The zero-point position can be changed by using the left and right keys for the specified channel.



   Fine adjustment of the zero point can be made when the FINE key LED is lighted. Channel specification is made by pressing the FINE key for the channel to be specified. When the STOP key is pressed, this stops.

2. Panel Check

   This is a check of the display channel LEDs, in which each LED is checked separately in sequence. Although the TRIG LED does not light, this does not indicate a problem. To terminate the check midway, simply press the STOP key.

3. RAM Initialization

   In normal use, setting conditions are held even when the power supply is switched off. This initialization is used when you need to initialize the setting conditions.

1.6.9 POLARITY REVERSE Function

The polarity reverse function enables reversal of the polarity of the inputs of channels 1 through 8.

- Polarity Switching Setting

  If the SHIFT key is pressed simultaneously with the POLREV (N) key, the polarity switching setting menu is displayed.

```
Modify Polarity
1. Yes   2. No
```

The cursor keys or numeric keys can be used to input "yes" or "no". If "yes" is input, the screen shown below is displayed and the polarity of channels 1 to 8 can be set. If "no" is input, the setting is terminated.

```
1ch Polarity
1. Posi  2. Nega
```

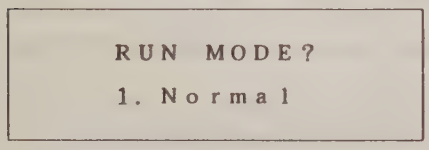
If Posi is input, the polarity of the input voltage does not change. If Nega is input, the input voltage is switched in polarity, so that a +1 V input will be processed internally as a −1 V input. The setting is made by the cursor keys or numeric keys and stops when all 8 channels have been set.

1.6.10 RUN Function

The RUN function includes the RUN MODE setting, and the RUN TIME setting selections. However, the RUN function setting is only valid in the direct Y-T recording mode.

- Run Mode Setting

If the SHIFT key is pressed simultaneously with the MODE (O) key, the RUN MODE setting menu is displayed.



→ 1. Normal

2. Trig-Start

3. Trg-Spd Change

4. Trg-Memory

The setting can be made by the cursor keys or by numeric keys. The following is a description of the operations selectable.

1. Normal

   Recording begins when the START key is pressed.

2. Trig-Start

   After the START key is pressed, recording starts when the trigger occurs.

3. Trg-Spd Change

   When the START key is pressed, recording starts. When the trigger occurs, the recording speed changes to the speed set as VAR. 2.

4. Trg-Memory (Option)

   Recording begins when the START key is pressed. When the trigger occurs, the recording mode changes from direct Y-T to memory Y-T.

Notes

1. If the Trig-Start and Trg-Spd Change are set, it is necessary to make the Trig function setting described later in this document.

2. If the Trg-Memory is set, it is necessary to make the Trig function and Memory function settings described later in this document.

- Run Time Setting

If the SHIFT key is pressed simultaneously with the TIME (P) key, the run time setting menu is displayed.

```
RUN  T/L?
1. Continue
```

→ 1. Continue
2. Time
3. Length

The setting can be made by the cursor keys or numeric keys. The operation is as follows.

1. Continue

After recording begins, it continues until the STOP key is pressed.

2. Time

When Time is selected, the following display appears.

```
Run  Time  (MM:SS)
```

This is the setting of the time from the beginning of recording until recording stops. It can be set in the range 1 second to 59 minutes 59 seconds.

3. Length

When Length is selected, the following display appears.

```
Run  Length
                ■■
```

This is the setting of the recording length from the start to the stop of recording. The setting can be made in the range 1 mm to 9999 mm.

1.6.11 TRIGGER Function

The TRIGGER function consists of the trigger source setting, trigger level setting, and trigger function setting. It is valid only in the direct Y-T and memory Y-T recording modes.

- Trigger Source Setting

If the SHIFT key is pressed simultaneously with the SRCE (Q) key, the trigger source setting menu is displayed.

```
Trigger  Source?
  1. Manual
```

→1. Manual
2. Internal
3. External

The setting can be made with cursor keys or with numeric keys. The operation is described below.

1. Manual

   When the START key is pressed once, recording is started (direct recording).

   When the START key is pressed twice, recording is started (memory recording).

2. Internal

   When the input conditions for the channel on which the trigger level is set are satisfied, recording begins.

3. External

   When a trigger start signal is input at the remote connector, recording begins. (This is a TTL low-level input or a short to the GND terminal.)

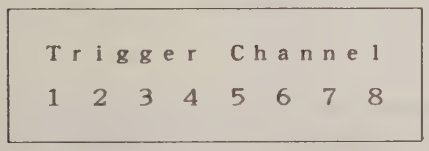
- Trigger Level Setting

If the SHIFT key is pressed simultaneously with the LEVEL (R) key, the trigger level menu setting is displayed. This is only valid, however, if the trigger source was set to internal.

The display changes through the sequence shown below.

Trigger Level Setting Menu

The trigger level can be set in the range −100% (lower voltage limit of input range) to +100% (upper voltage limit of input range). The setting is made using numeric keys.



Trigger Channel Setting Menu

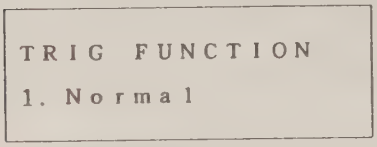
The trigger channel is selected as one channel of channels 1 through 8. The cursor keys are used to make this setting.

Trigger Slope Setting Menu

The trigger slope is set to rising edge (▲) or falling edge (▼). The cursor keys are used for this setting.

- Trigger Function Setting (Option)

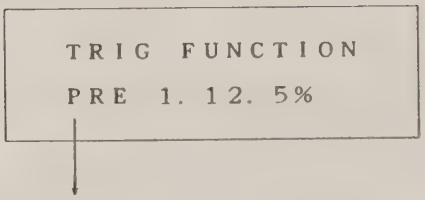
If the SHIFT key is pressed simultaneously with the PRE (S) key, the trigger function setting menu is displayed. Settings are made using the cursor or the numeric keys.



1. Normal
2. Pre
3. Post

If a setting other than normal is made for the trigger function, the display shown below appears and the trigger offset must be set.

Pre or Post Setting



1. 12.5%
2. 25 %
3. 50 %
4. 100 %

PRE or POST

Note

The pre-trigger or post-trigger setting is valid only for memory recording. If a direct recording mode has been selected, even if pre-triggering is set, the recorder will operate with normal triggering. To perform memory recording, it is necessary to make the memory function setting.

Next, the memory size setting screen appears.

```
Memory Volume?
1.  0.25kword
```

→

1. 0.25 Kwords
2. 0.5 Kwords
3. 1 Kword
4. 2 Kwords
5. 4 Kwords
6. 8 Kwords
7. 16 Kwords
8. 32 Kwords

The relationship between the memory volume and the recording time depends upon the sampling time established in the memory function setting (see Table 1).

1.6.12 MEMORY Function (Option)

The MEMORY function includes the sampling time setting, and scaling factor setting function.

- Sampling Time Setting

  If the SHIFT key is pressed simultaneously with the SMPL (T) key, the sampling time setting menu is displayed.

```
Sampling Time?
    10μsec
```

→

10 μs,	20 μs
50 μs,	100 μs
200 μs,	500 μs
1 ms,	2 ms
5 ms,	10 ms
20 ms,	50 ms
100 ms,	200 ms
500 ms	External

  The cursor keys are used to set the sampling time. If External is specified, data is sampled in synchronization with an external sampling clock. The maximum clock frequency is 100 kHz.

- Scaling Factor Setting

  If the SHIFT key is pressed simultaneously with the OUT (U) key, the scaling factor setting menu is displayed.

```
Scaling Factor
  1. 1/1
```

→ 1. 1/1
2. 1/2
3. 1/4
4. 1/8

For example, if the scaling factor is set to 1/2, for Y-T recording, the T axis will be compressed by 1/2. For X-Y recording, this setting is invalid.

Next, the output memory area setting screen is displayed.

```
Out Memory Area
1. FIX   2. Set
```

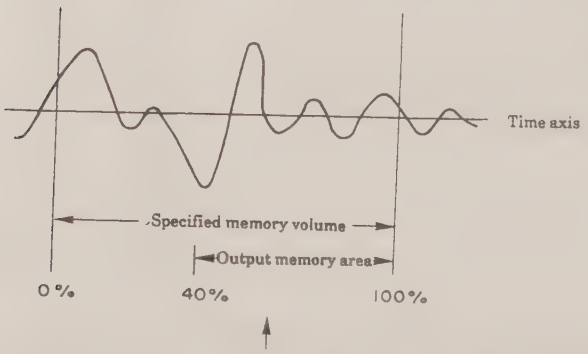
If FIX is specified as the output memory area, all of the data specified by the memory volume will be recorded. If Set is specified, the menu shown below is displayed and only data from a specified area in the memory volume will be stored in RAM and used as data.

```
Out Memory Area
  00% - 100%
```

→ Left value: 0 to 99

Right value: 1 to 100

Setting is made by using numeric keys. However, the right-side value must be set to a value larger than the left-side value.



Output memory area setting of 40%-100%

Output Memory Area Data Example

1.6.13 DATA SCALE Function

The DATA SCALE function includes the logging scale setting and the logging interval setting functions. The settings for these functions are only valid for logging recording.

- Logging Scale Setting

If the SHIFT key is pressed simultaneously with the DATASCALE (V) key, the logging scale setting menu is displayed.

```
Logging Scale?
1. Yes   2. No
```

If the logging scale is set to "yes", the following menu appears. If "no" is selected, the logging interval setting menu appears.

```
Logging Scale
LS-99999 HS-99999
```

→ LS: Lower-limit value for the input range
US: Upper-limit value for the input range

The scale values can be input in the range −99999 to +99999. However, a decimal point may not be input.

Setting Conditions

Input range:	±10 V/FS
LS	−10000
HS	10000

With the above conditions set, for an input of +5 V, the logging value would be 5000.

When the logging scale value is set, the display changes to the logging interval setting screen. The setting is made by cursor keys or by numeric keys.

```
Logging Interval
  1.  1sec
```

→ 1. 1 s
2. 10 s
3. 1 min
4. 10 min

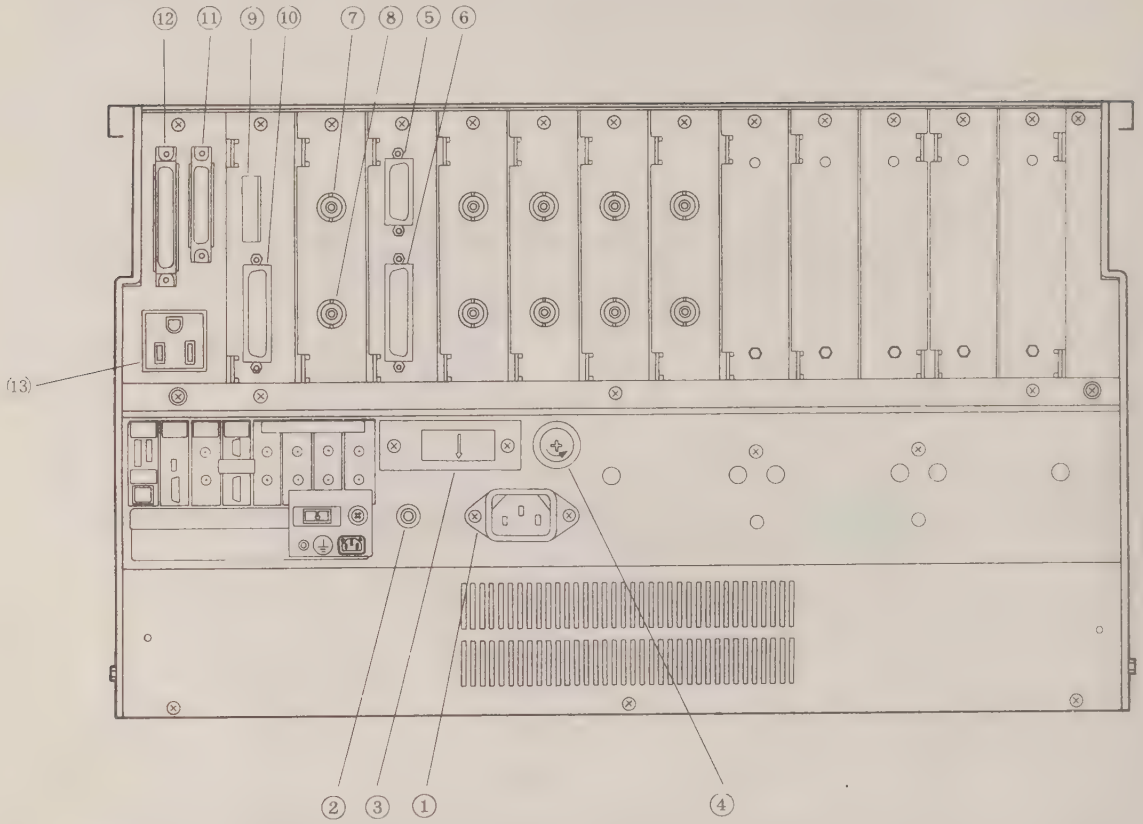
1.6.14 Other Secondary Level Function Key Descriptions

(a) If the SHIFT key is pressed simultaneously with the INS (W) key, the insert key function can be used. This can be used, for example, in setting annotation to insert a single character.

(b) If the SHIFT key is pressed simultaneously with the DEL (X) key, the delete key function can be used. This can be used, for example, when setting annotation to delete a single character.

(c) If the SHIFT key is pressed simultaneously with the + (Y) key or the − (Z) key, the sign can be entered.

1.7 Rear Panel Description



① AC LINE inlet: The AC power cord is connected here. (A protective ground terminal is provided.)

② GND terminal: This terminal is connected to the WR3600's case. When the line plug does not have a protective ground pin, this terminal should be connected to a separate ground to provide a ground for the cabinet.

③ VOLTAGE SELECTOR: Used to set the line voltage. Insert the selector so that the arrow points to the desired line voltage.

④ FUSE holder: Contains a protective fuse that protects the WR3600 from overcurrent conditions. Turn in the direction of the arrow and pull out to replace the fuse.

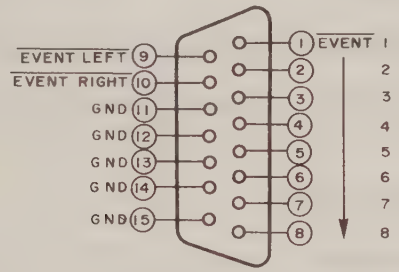
Caution

① Always remove the power cord from its outlet when replacing a fuse.

② When a fuse is replaced, always use a new fuse of the same type. Never repair a fuse or use a fuse having a different rating.

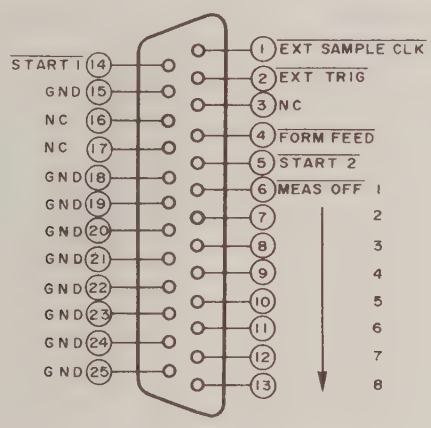
③ When first connecting the power line, be sure the VOLTAGE SELECTOR is set to the proper line voltage.

⑤ Event (remote) Connector: This connector is used to input signals for event recording. The pin arrangement is shown below.



Apply a TTL low-level signal to pin terminals or short them to ground to record events.

⑥ CONTROL (remote) connector: This connector is used to input control signals. The connector pin arrangement is shown below.



- $\overline{\text{EXT SAMPLE CLK}}$: This is the clock input used for externally synced sampling. A TTL-level signal in the range 0 to 10^5 pps should be input.

- $\overline{\text{EXT TRIG}}$: External trigger input. The trigger is applied when a TTL low-level input is applied or when the pin is shorted to the GND pin.

- $\overline{\text{FORM FEED}}$: When a TTL low-level signal is input or this pin is shorted to the GND pin, the chart paper feeds by a predetermined amount.

- $\overline{\text{MEAS OFF}}$ 1 to 8: Measurement off inputs. Inputting a TTL low-level signal or shorting a pin to the GND pin places the corresponding channel in the MEAS OFF condition.

- $\overline{\text{START}}$ 1: Start input. Inputting a TTL low-level signal or shorting this pin to the GND pin causes recording to start.

- $\overline{\text{START}}$. 2: Start input. The falling edge of a signal applied to this pin causes recording to start. This pin cannot be used to stop recording.

⑦ TIME CODE IN Connector: This connector is used to input an IRIG signal.

⑧ TIME CODE OUT Connector: This connector is used to output an IRIG signal.

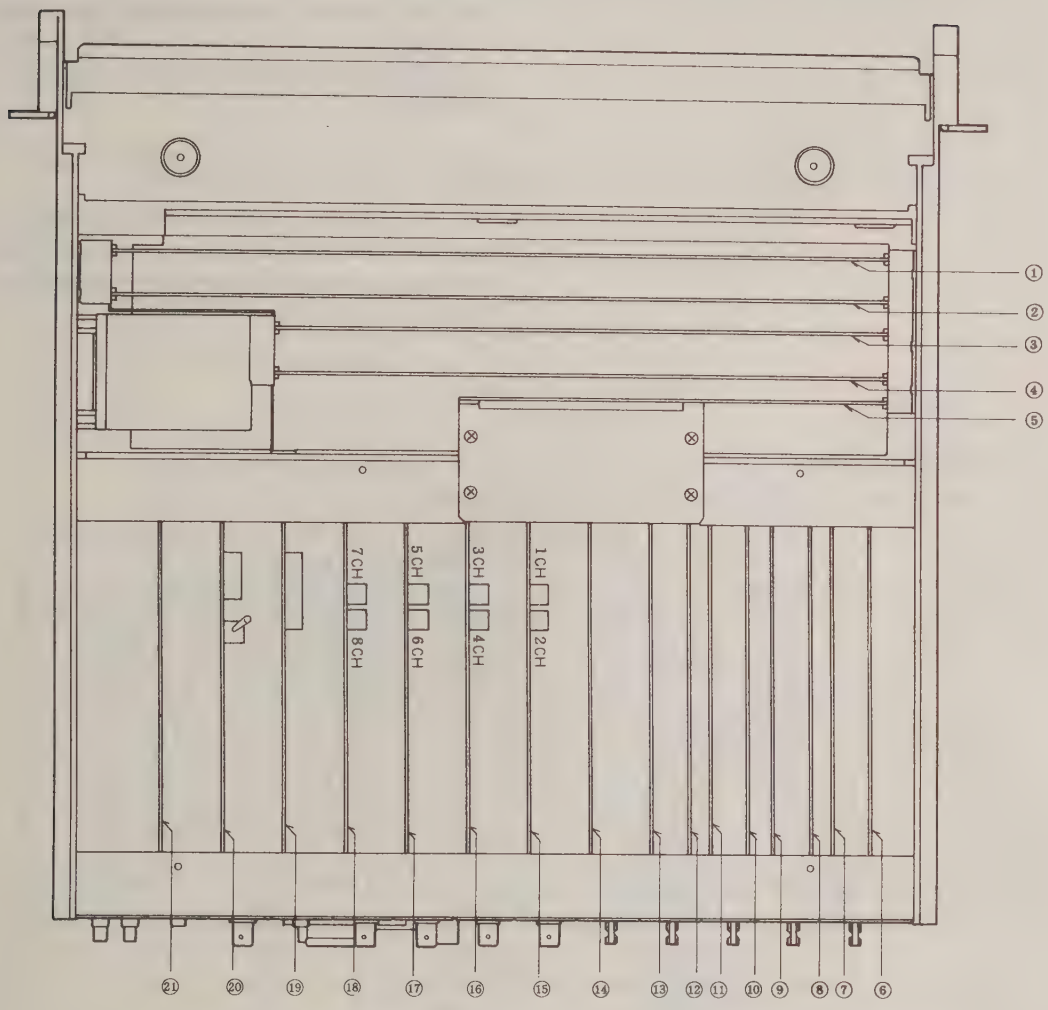
⑨ Interface setting switches

⑩ Interface connector

For details, see Section 3.

1.8 PC Board Locations and Functions

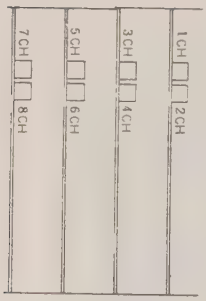
1.8.1 PC Board Locations



①	PR3600-102	SLAVE CPU	⑪	MEMORY BOARD B
②	PR3600-02	MASTER CPU	⑫	COMPARATOR B
③	PR3600-03	MASTER HEAD DRIVER	⑬	COMPARATOR A
④	PR3600-03	SLAVE HEAD DRIVER	⑭	MEMORY CONTROL
⑤	PR3600-04	CHART DRIVER	⑮ to ⑱	A/D BOARD
⑥	PR3600-06	MEMORY BOARD A	⑲	I/F REMOTE
⑦	PR3600-106	MEMORY BOARD B	⑳	I/F IRIG
⑧	PR3600-07	COMPARATOR B	㉑	I/F RS-232C or GPIB
⑨	PR3600-08	COMPARATOR A		
⑩	PR3600-06	MEMORY BOARD A		

1.8.2 Switch Settings

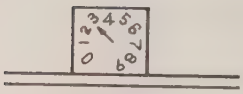
① A/D Board



Amplifier input range switching is made for each channel independently using the DIP switches on the A/D boards. The arrangement of the DIP switches is shown at the left.

(Range switching and recordable ranges)

The table below shows the relationship of the DIP switch settings to the input voltage ranges and recordable ranges for the various settings of POSITION.

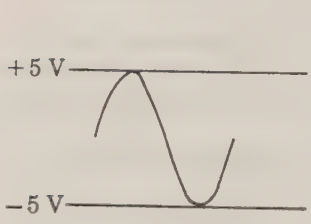


DIP Switch

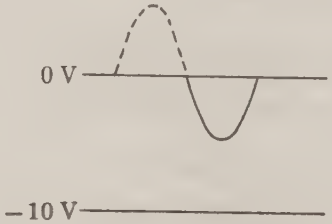
DIP Switch	Input voltage range	Recording range		
		Position setting 0%	Position setting −100%	Position setting +100%
0	±10 V/FS	−5 to +5 V	−10 to 0 V	0 to +10 V
1	±5 V/FS	−2.5 to +2.5 V	−5 to 0 V	0 to +5 V
2	±2.5 V/FS	−1.25 to +1.25 V	−2.5 to 0 V	0 to +2.5 V
3	±1 V/FS	−0.5 to +0.5 V	−1 to 0 V	0 to +1 V
4 to 9	±0.5 V/FS	−0.25 to +0.25 V	−0.5 to 0 V	0 to +0.5 V

Recording range example: DIP Switch 0

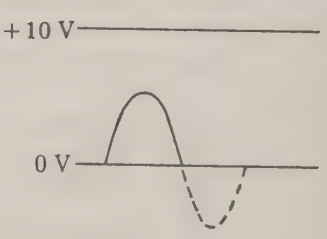
Input signal: ±5-V sinewave



Position 0%



Position −100%



Position +100%

② I/F REMOTE Board

The DIP switches on the I/F REMOTE board (shown below) are used to establish the sense (negative true or positive true) of external remote signals.

The table below shows the relationship between and external remote signal polarities.

Switch Setting / Switch	ON	OFF
1	EVENT RIGHT	$\overline{\text{EVENT RIGHT}}$
2	EVENT LEFT	$\overline{\text{EVENT LEFT}}$
3	EVENT 8	$\overline{\text{EVENT 8}}$
4	EVENT 7	$\overline{\text{EVENT 7}}$
5	EVENT 6	$\overline{\text{EVENT 6}}$
6	EVENT 5	$\overline{\text{EVENT 5}}$
7	EVENT 4	$\overline{\text{EVENT 4}}$
8	EVENT 3	$\overline{\text{EVENT 3}}$
9	EVENT 2	$\overline{\text{EVENT 2}}$
10	EVENT 1	$\overline{\text{EVENT 1}}$

③ I/F IRIG Board

The DIP switches on the IRIG board (shown below) are used to select the IRIG signal (A, B, E, NASA 36).

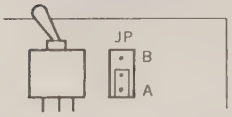
The relationship between DIP switch settings and the IRIG signal selected are shown below.

Switch / Signal Type	1	2	3	4
IRIG-A	ON	OFF	OFF	OFF
IRIG-B	OFF	ON	OFF	OFF
IRIG-E	OFF	OFF	ON	OFF
NASA 36	OFF	OFF	OFF	ON

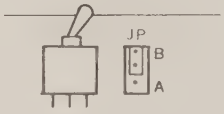
Do not set more than one switch to ON at any given time

The relationship between input signal type (TTL or AC) and toggle switch settings is shown below.

TTL input



AC input



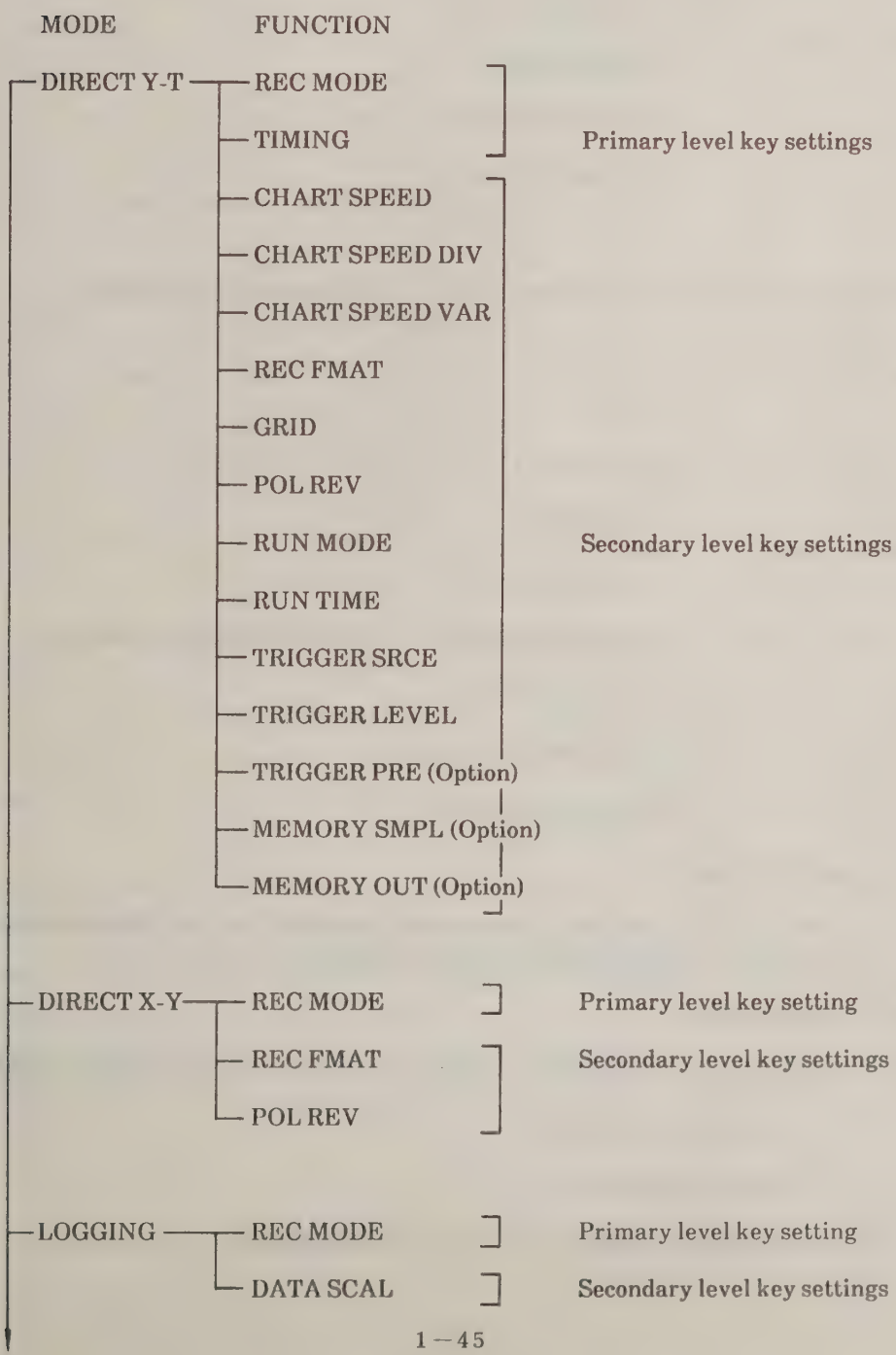
1.9 Menu Configuration

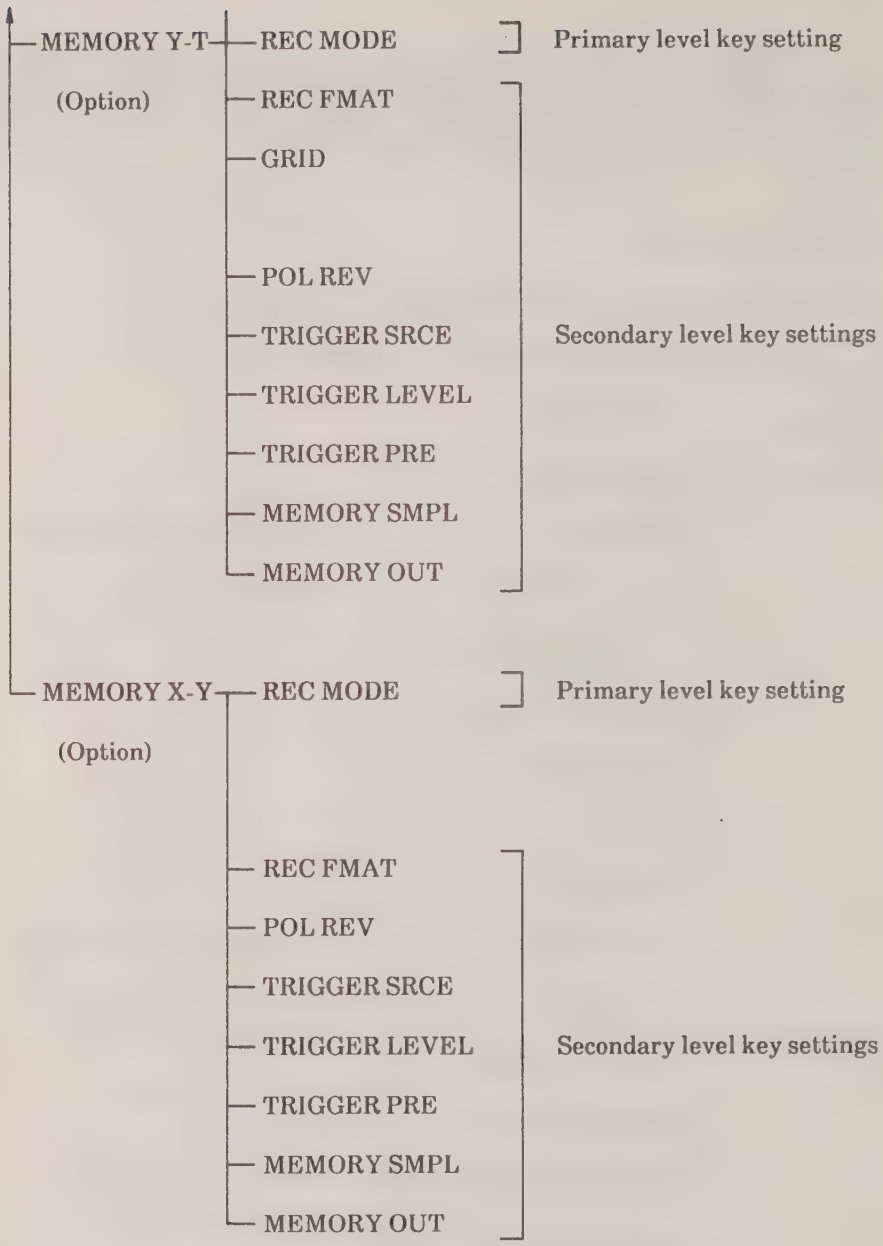
As described in the specifications section of this manual, the WR3600 has a large number of processing functions. Menus settings are used to select just the desired functions and operations. This section will describe the general setting procedure. Details on individual operations are included in Section 2 and beyond in this manual.

1.9.1 Menu Tree Structure

The structure of the menus used to make settings is shown below.

- Operating mode menus (the memory function is optional)





1.9.2 Initial Settings

In the system test function, if Ram Init is selected and the ENTER key is pressed, all previous settings will be lost, and the WR3600 will be initialized.

1.10 Error Alarm

Whenever the following occurs, an alarm is sounded and the recording is stopped.

- Print head up condition
- No recording paper
- Improper mounting of the chart paper stock section

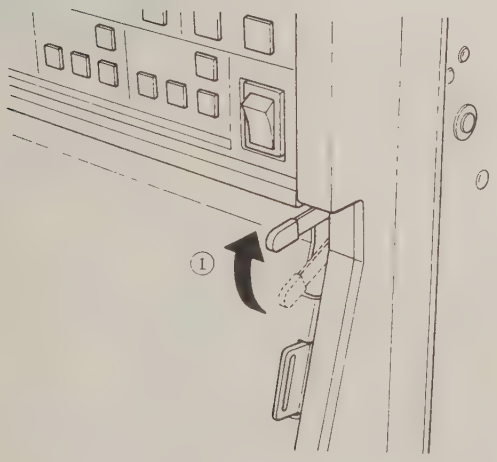
Attached Table 1

Interval \ Memory size	Data Acquisition Times							
	0.25	0.5	1	2	4	8	16	32Kwords
10 μs	2.56ms	5.12ms	10.24ms	20.48ms	40.96ms	81.92ms	163.84ms	327.68ms
20 μs	5.12ms	10.24ms	20.48ms	40.96ms	81.92ms	163.84ms	327.68ms	655.36ms
50 μs	12.82ms	25.64ms	51.2ms	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s
100 μs	25.6ms	51.2ms	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s	3.2768s
200 μs	51.2ms	102.4ms	204.8ms	409.6ms	819.2ms	1.6384s	3.2768s	6.5536s
500 μs	128ms	256ms	512ms	1.024s	2.048s	4.096s	8.192s	16.384s
1 ms	256ms	512ms	1.024s	2.048s	4.096s	8.192s	16.384s	32.768s
2 ms	512ms	1.024s	2.048s	4.096s	8.192s	16.384s	32.768s	65.536s
5 ms	1.28s	2.56s	5.12s	10.24s	20.48s	40.96s	81.92s	163.84s
10 ms	2.56s	5.12s	10.24s	20.48s	40.96s	81.92s	163.84s	327.68s
20 ms	5.12s	10.24s	20.48s	40.96s	81.92s	163.84s	327.68s	655.36s
50 ms	12.82s	25.64s	51.2s	102.4s	204.8s	409.6s	819.2s	1638.4s
100 ms	25.6s	51.2s	102.4s	204.8s	409.6s	819.2s	1638.4s	3276.8s
200 ms	51.2s	102.4s	204.8s	409.6s	819.2s	1638.4s	3276.8s	6553.6s
500 ms	128s	256s	512s	1024s	2048s	4096s	8192s	16384s

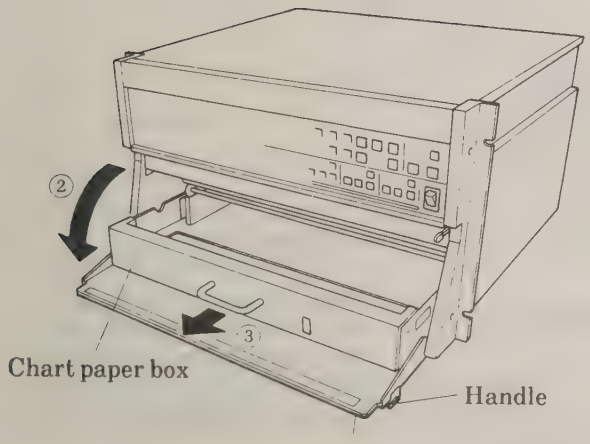
2. MEASUREMENT AND RECORDING IN THE VARIOUS RECORDING MODES

2.1 Mounting Recording Paper

2.1.1 Procedure



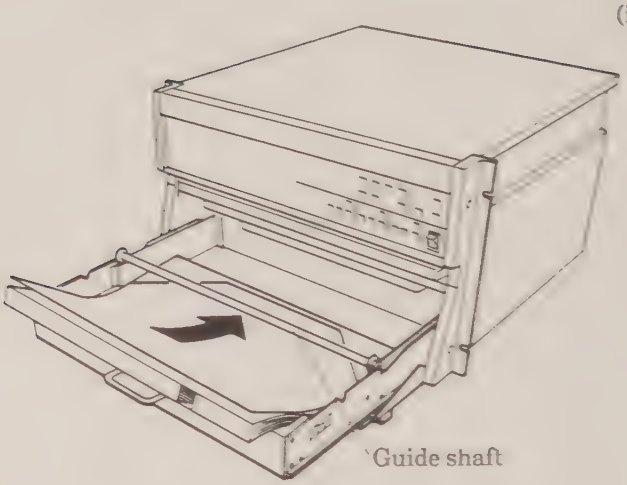
① Lift the lever.



② Hold the handles at both sides of the recording panel and open the panel.

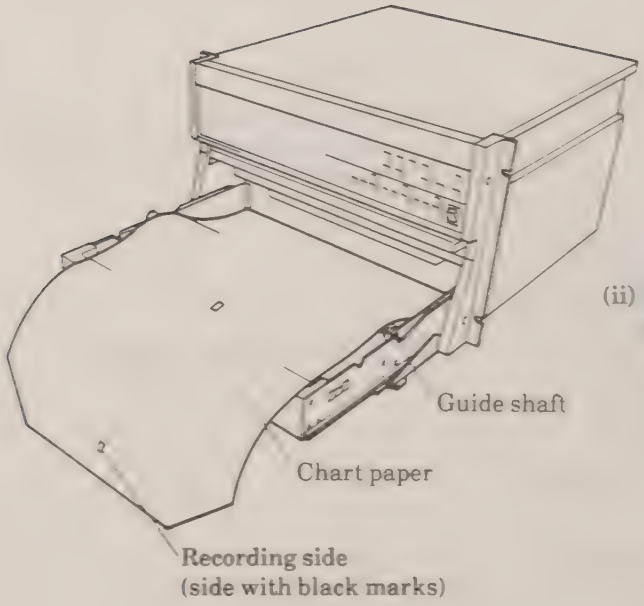
③ Pull out the chart paper box.

④-1 Z-fold paper



(i) Place the chart paper into the chart paper box.

- For 200-m-long chart paper, remove the guide shaft before placing the paper in the box. Then replace the guide shaft



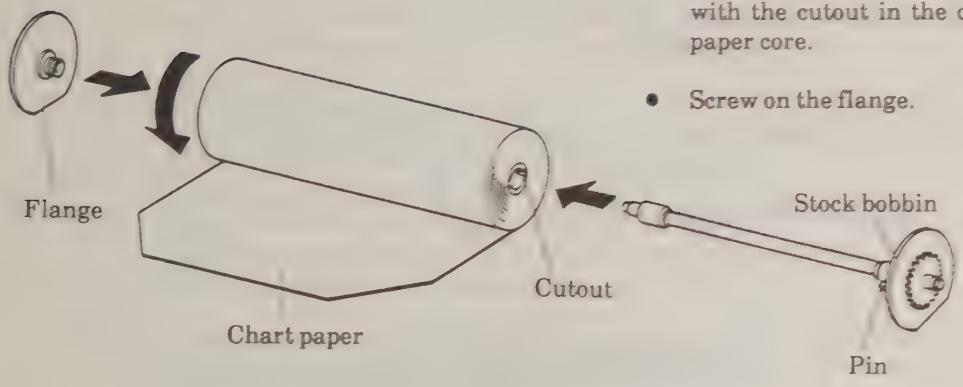
(ii) Pass the chart paper over the guide and pull it out.

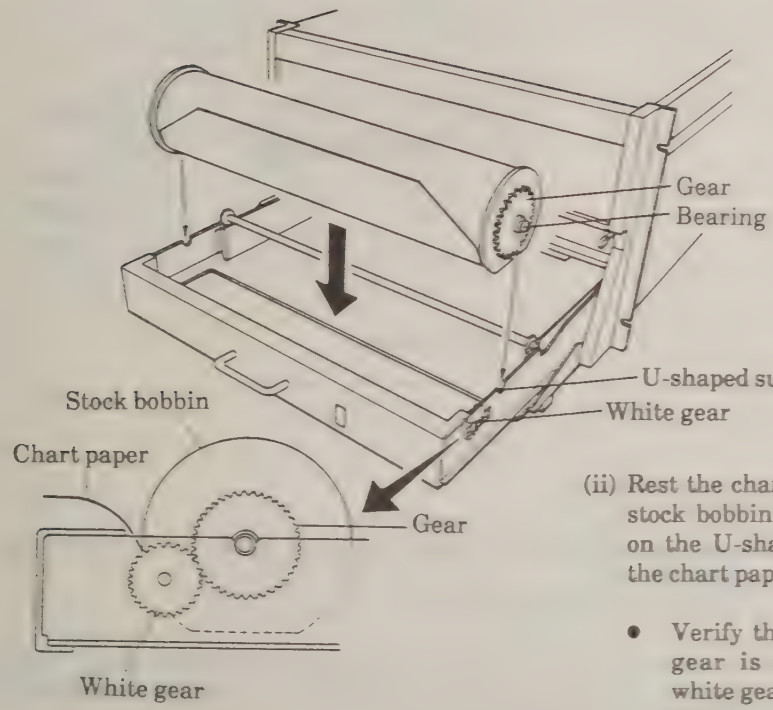
- When doing this, verify that the recording side of the chart paper (i.e., the side having the black marks in the center) is facing up.

④-2 Roll paper

(i) Mount the chart paper on the stock bobbin.

- Align the stock bobbin pin with the cutout in the chart paper core.
- Screw on the flange.





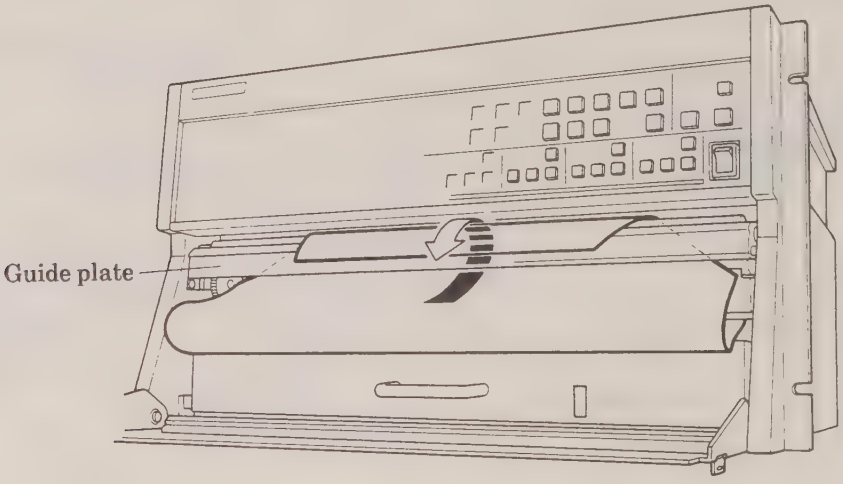
(ii) Rest the chart paper so that the stock bobbin bearings are lying on the U-shaped receptacles in the chart paper box.

- Verify that the stock bobbin gear is meshed with the white gear in the chart paper box.

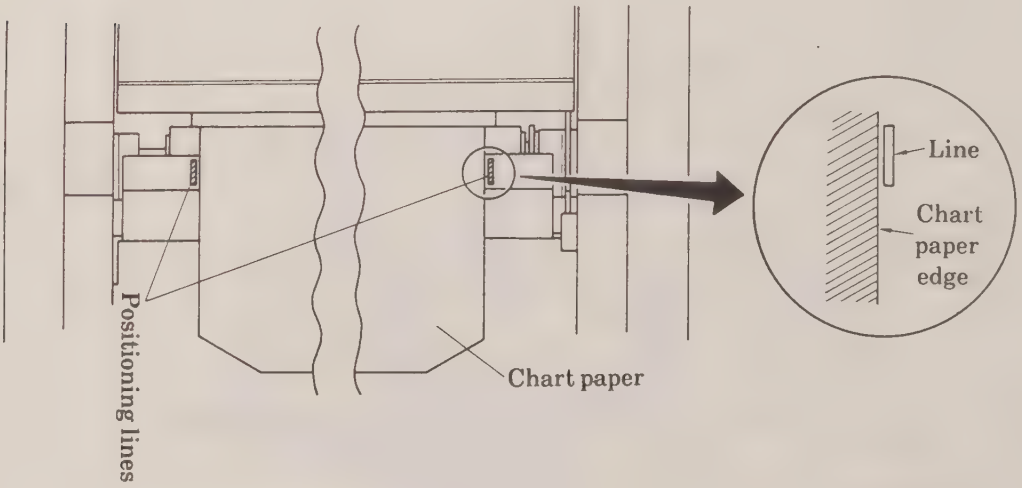
(iii) Pull the recording paper out.

⑤ Push the chart paper box into the recorder mainframe.

⑥ Feed the paper over the guide plate until it exits the recorder.



⑦ Pull the chart paper *straight out* about 30 to 50 cm, and lower the lever *after aligning the chart paper at both ends with the positioning lines.*



⑧ Close the recording panel.

If the recording panel cannot be closed, the chart paper box has not been pushed in completely.

Notes

1. The last approximate 1-m section of chart paper has a red line marked on it to indicate that the end of the paper is near.

2. The chart paper is thermally sensitive on only one side. The thermal recording head is above the rubber roller. Therefore, if the chart paper is not fed correctly, recording will not be possible.

2.2 Connecting and Applying Power

2.2.1 Precautions

- Use only the accessory power cord with the protective ground provided.
- When extending the above-mentioned power cord, make connections to the power cord using the adaptor provided and, in cases in which a good protective ground is not connected to the power supply, always provide a separate protective ground wire at the gnd terminal.
- When providing a separate protective ground, make the connection directly to the GND terminal. This connection must not be made to the input cable guard lead.
- Make absolutely certain that the VOLTAGE SELECTOR setting position matches the voltage of the AC power line to be used. If it does not, make the settings as described in Section 2.2.2.
- Extreme care is required in checking that the VOLTAGE SELECTOR is set properly, as improper setting can result in irreparable damage to the recorder.

2.2.2 VOLTAGE SELECTOR Setting

The VOLTAGE SELECTOR should be set by the following procedure.

① Set the POWER switch to OFF.

② Insert the selector plug so that the arrow is aligned with the desired voltage setting.

③ When changing from 100 or 117 V to 220 or 240 V or vice versa, the fuse must be replaced with one of the proper rating.

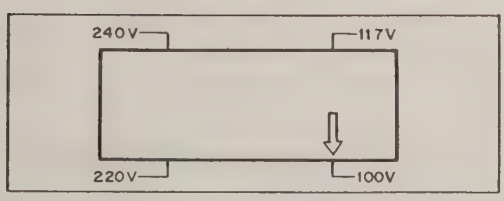


Fig. 2-1 VOLTAGE SELECTOR Setting

2.2.3 Power Cord Connection and Powering the Recorder On

After installing the chart paper and setting the VOLTAGE SELECTOR properly, connect the power cord and apply power as follows.

① Connect the female end of the accessory power cord (Fig. 2-2) to the AC line connector of the WR3600.

Fig. 2-2 Power Cord and Adaptor

② Connect the plug of the power cord to the AC line outlet.

③ Set the POWER switch to on. At this point the LCD display will appear as shown in Fig. 2-3.

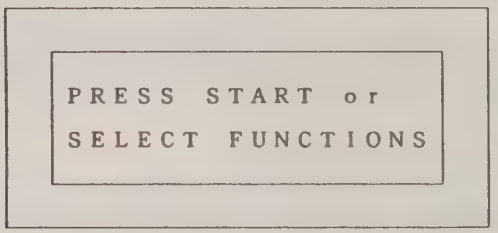


Fig. 2-3 LCD Message after Power Is Applied

The message shown in Fig. 2-3 is the initial screen. If this message appears after connecting and applying power, it is an indication that the recorder is operating properly.

2.2.4 Date and Time Setting Procedure

To set the date and time, the date and time setting menu is recalled and the settings are made as follows.

① Press the SHIFT key and the DATE/TIME SET (A) key simultaneously to recall the menu. (Fig. 2-4).

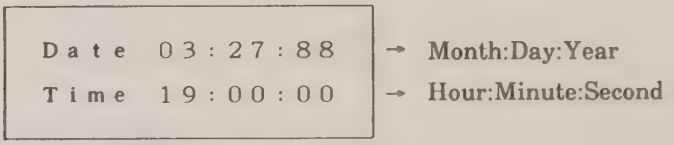


Fig. 2-4 Date and Time Setting Menu

② The blinking cursor indicates the position of the value that can be input. Use the up/left and down/right keys to move the cursor to the desired position and use the numeric keys (0 to 9) to enter the value, terminating this by pressing the ENTER KEY. At this point, the LCD will return to the initial screen.

2.2.5 Verification of Date and Time

Verification of the date and time is performed at the operating panel LED display.

Each time the DATE/TIME key on the operating panel is pressed, the date and time will appear on the LED display alternately (Fig. 2-5).

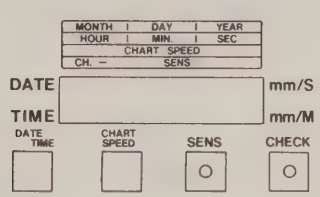


Fig. 2-5 LED Display

2.3 Direct Y-T Mode Operation

The WR3600 can be used in the direct Y-T mode as described below. This enables real-time continuous recording.

2.3.1 Mode Selection

With the WR3600 in the STOP condition, press the REC MODE key so that the LED display indicates DIRECT (Fig. 2-6).

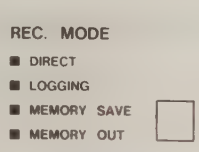


Fig. 2-6

2.3.2 Recording Format Setting

Press the SHIFT key and the REC FMAT (F) key simultaneously to recall the recording format setting menu (Fig. 2-7).

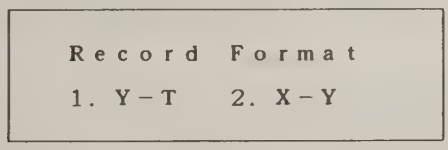


Fig. 2-7

① Recording Format Setting

Use the cursor keys to move the blinking cursor to the Y-T position and press the ENTER key to make the setting. The screen will change to the recording width setting screen (Fig. 2-8).

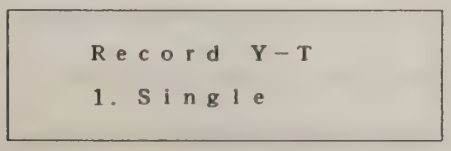


Fig. 2-8

② Recording Width Setting

Use the cursor keys to display the selected item and press ENTER to make the setting. The screen will change to the list print setting (Fig. 2-9).

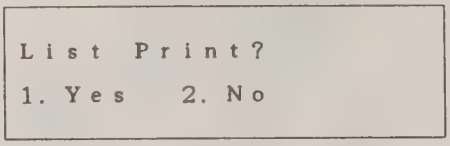


Fig. 2-9

1. Single (40 mm width)

2. Double (80 mm width)

3. Wide (160 mm width)

For recording, refer to Recording Example 1.

③ List Print Setting

Use the cursor keys to move the blinking cursor to the item to be selected and press the ENTER key to make the setting.

If Yes was set, the list will begin as follows.

For roll paper: List printing is performed immediately after recording is stopped.

For Z-fold paper: List printing is performed after recording is stopped and a page feed is performed.

Refer to the List Recording Example 1.

2.3.3 Time Marker Setting

The TIMING key is pressed to set the time marker time interval. The LED corresponding to the setting will light (Fig. 2-10).

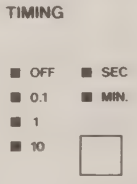


Fig. 2-10

For recording, refer to Recording Example 4.

2.3.4 Chart Speed Setting

① Numeric keys: used to set the chart speed values.

② /SEC key: Used to select the chart speed units.

③ /MIN key: Used to select the chart speed units.

④ DIV. BY key: Used to set the divider for the above-described chart speed values. When using this, it is necessary to make a function key selection of the division ratio (1/10, 1/60. 1/100).

⑤ VAR. 1, VAR. 2 keys: Used to set an arbitrary chart speed. When these are used, it is necessary to make a function key selection of arbitrary chart speed.

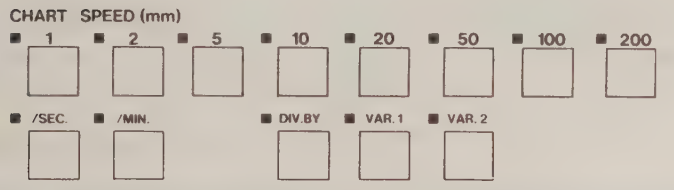


Fig. 2-11

2.3.5 Chart Speed Divisor (DIV. BY) Setting

If the SHIFT and the CHT SPEED DIV (E) keys are pressed simultaneously, the chart speed division setting menu is displayed (Fig. 2-12)

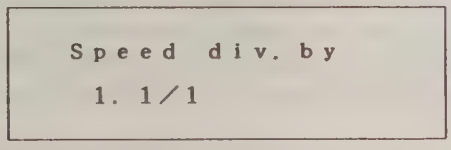


Fig. 2-12

Use the cursor keys to display the desired item and press the ENTER key to make the setting. The 1/n division setting can be made as 1/10, 1/60, or 1/100. Therefore, in addition to the 1 to 200 mm/sec or min settings of the CHART SPEED group, the following chart speeds can be set.

1 to 200 mm/s or min *1/n

2.3.6 Arbitrary Chart Speed Setting

If the VAR. 1 or VAR. 2 of the primary level key CHART SPEED group is selected and the SHIFT and CHART SPEED VAR (D) keys are pressed simultaneously, the VAR 1 or VAR. 2 arbitrary chart speed setting function is selected.

If a primary level key other than VAR. 1 or VAR. 2 (1 to 200) is set, the display will appear as shown in Fig. 2-13.

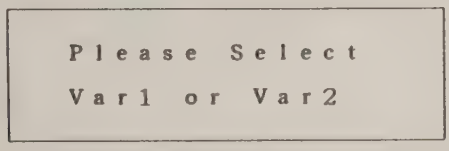


Fig. 2-13

If the above display appears, select VAR. 1 or VAR. 2 from the primary level CHART SPEED key group to enable the arbitrary chart speed setting function.

If VAR. 1 is selected, the display appears as shown in Fig. 2-14.

If VAR. 2 is selected the display appears the same except that V. 1 is replaced by V. 2.

Fig. 2-14

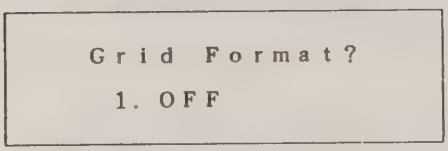
The blinking cursor indicates the part of the display that can be input. Use the numeric keys to perform input, and specify the time units when the 1 is blinking as seconds by pressing S or minutes by pressing the M key. The input range is 000.1 mm/s or min to 200.0 mm/s or min, set in 000.1 steps. Also, a special setting of 500.0/s or min can be input. When the setting is completed, press ENTER.

Note

When making settings, always position the decimal point between the third and fourth digits. Also, always input leading zeros using the 0 key so that the field to the left of the decimal point consists of three digits. When making both VAR. 1 and VAR. 2 settings, perform the same procedure twice.

2.3.7 Grid Setting

If the SHIFT key and GRID (G) key are pressed simultaneously, the GRID format setting menu is displayed (Fig. 2-15).



1: OFF

2: 10 mm × 10 mm

3: 5 mm × 5 mm

4: 5 mm × 4 mm

① GRID Format Setting

Use the cursor keys or the numeric keys to make the setting. If the GRID Format setting is selected as OFF the GRID function setting is terminated. If a value in the range 2 to 4 is selected from the GRID format menu setting, the fine grid setting menu is displayed (Fig 2-16).

Fig. 2-16

② Fine Grid Setting

Settings can be made with the cursor keys or with the numeric keys. Press the ENTER key to make the setting. If the fine grid "Yes" setting is made, fine grids with an interval of 1 mm are printed between other grid lines. Refer to Recording Example 3 for the grid format.

2.3.8 Polarity Reverse Setting

If the SHIFT key is pressed simultaneously with the POLREV (N) key, the polarity switching setting menu is displayed (Fig. 2-17).

Fig. 2-17

① Modify Polarity Setting

With the display as shown in Fig. 2-17, use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "yes" is set, the screen used to set the polarity of channels 1 to 8 is displayed (Fig. 2-18).

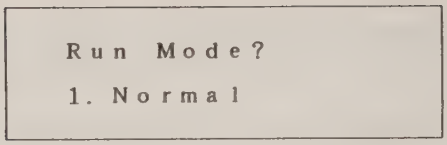
Fig. 2-18

② Individual Channel Polarity Settings

Use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "Posi" is input, the polarity of the input voltage does not change. If "Nega" is input, the input voltage is switched in polarity, so that a +1 V input will be processed internally as a −1 V input. The setting is made by the cursor keys or numeric keys and stops when all 8 channels have been set.

2.3.9 Run Mode Setting

If the SHIFT key is pressed simultaneously with the MODE (O) key, the RUN MODE setting menu is displayed (Fig. 2-19).



1. Normal
2. Trig-Start
3. Trg-Spd Change
4. Trg-Memory

The setting can be made by the cursor keys or by numeric keys. The following is a description of the operations selectable.

1. Normal

   Recording begins when the START key is pressed.

2. Trig-Start

   After the START key is pressed, recording starts when the trigger occurs.

3. Trg-Spd Change

   When the START key is pressed, recording starts. When the trigger occurs, the recording speed changes to the speed set as VAR. 2.

4. Trg-Memory (Option)

   Recording begins when the START key is pressed. When the trigger occurs, the recording mode changes from direct Y-T to memory Y-T.

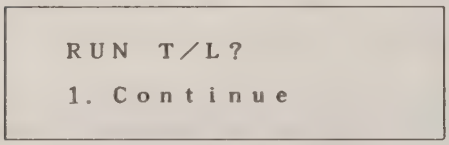
   Note

   1. If the Trig-Start and Trg-Spd Change are set, it is necessary to make the Trig function setting described later in this document.

   2. If the Trg-Memory is set, it is necessary to make the Trig function and Memory function settings described later in this document.

2.3.10 Run Time Setting

If the SHIFT key is pressed simultaneously with the TIME (P) key, the run time setting menu is displayed.



1. Continue
2. Time
3. Length

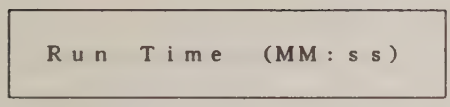
The setting can be made by the cursor keys or numeric keys. The operation is as follows.

1. Continue

   After recording begins, it continues until the STOP key is pressed.

2. Time

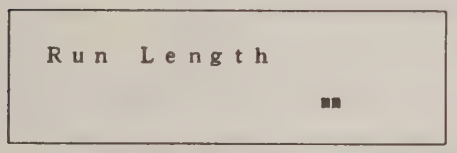
   When Time is selected, the following display appears.



This is the setting of the time from the beginning of recording until recording stops. It can be set in the range 1 second to 59 minutes 59 seconds.

3. Length

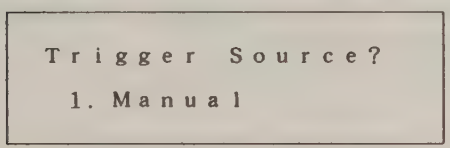
When Length is selected, the following display appears.



This is the setting of the recording length from the start to the stop of recording. The setting can be made in the range 1 mm to 9999 mm.

2.3.11 Trigger Source Setting

If the SHIFT key is pressed simultaneously with the SRCE (Q) key, the trigger source setting menu is displayed.



1. Manual
2. Internal
3. External

The setting can be made with cursor keys or with numeric keys. The operation is described below.

1. Manual

When the START key is pressed once, recording is started (direct recording).

When the START key is pressed twice, recording is started (memory recording).

2. Internal

When the input conditions for the channel on which the trigger level is set are satisfied, recording begins.

3. External

When a trigger start signal is input at the remote connector, recording begins. (This is a TTL low-level input or a short to the GND terminal.)

2.3.12 Trigger Level Setting

If the SHIFT key is pressed simultaneously with the LEVEL (R) key, the trigger level menu setting is displayed (Fig. 2-22). This is only valid, however, if the trigger source was set to internal.

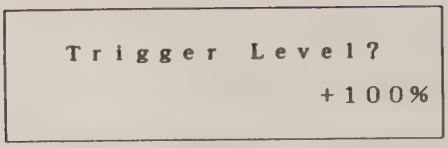


Fig. 2-22

① Trigger Level Setting

The trigger level can be set in the range −100% (lower voltage limit of input range) to +100% (upper voltage limit of input range). The setting is made using numeric keys, and when the ENTER key is pressed, the screen changes to the trigger channel setting screen (Fig. 2-23).

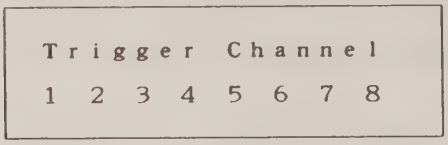


Fig. 2-23

While it is possible to input 1% steps, internal settings are made in 2% steps.

② Trigger Channel Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting. The trigger channel is selected as one channel of channels 1 through 8. When this is done, the screen changes to the trigger slope setting display (Fig. 2-24).

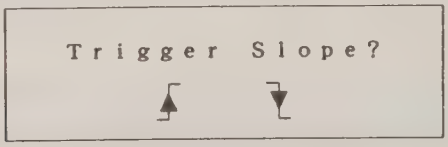


Fig. 2-24

③ Trigger Slope Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting.

The trigger slope can be set to rising edge ( ) or falling edge ( ) of the input signal.

Trigger Level Example

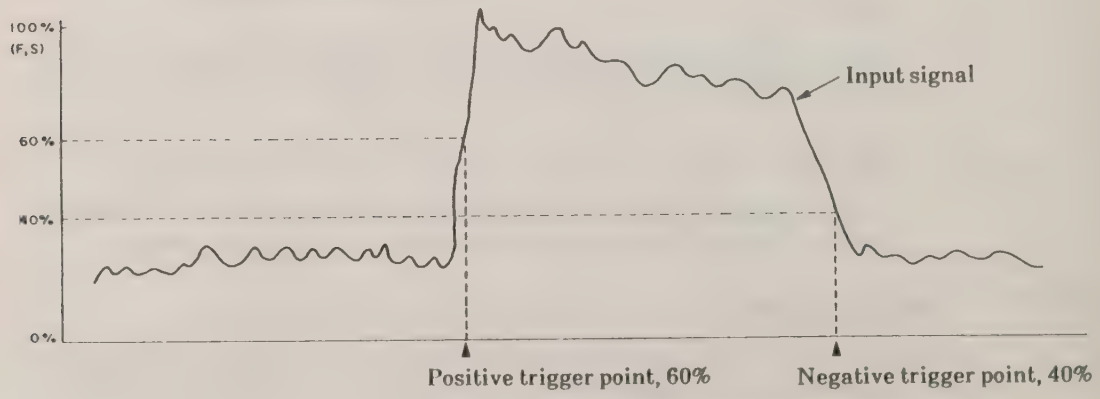


Fig. 2-25 (Input Range: ±10 V Full Scale)

2.3.13 Trigger Function Setting

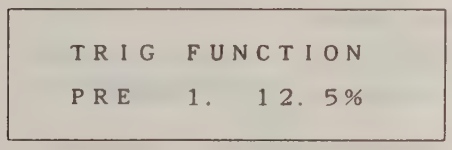
If the SHIFT key is pressed simultaneously with the PRE (S) key, the trigger function setting menu is displayed. Settings are made using the cursor or the numeric keys (Fig. 2-26).

1. Normal
2. Pre
3. Post

Fig. 2-26

① Trigger Function Setting

Use the cursor keys to display the desired item and press the ENTER key to make the setting. If the normal setting function had been made, the screen will change to the trigger offset setting menu (Fig. 2-27).



1. 12.5%
2. 25 %
3. 50 %
4. 100 %

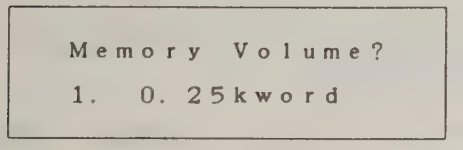
Fig. 2-27

② Trigger Offset Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The screen will change to the memory size setting menu (Fig. 2-28).

Note

The pre-trigger or post-trigger setting is valid only for memory recording. If a direct recording mode has been selected, even if pre-triggering is set, the recorder will operate with normal triggering. To perform memory recording, it is necessary to make the memory function setting. For direct Y-T recording, and the setting of Trg-Memory, settings of ② and below are valid.



1. 0.25 Kwords
2. 0.5 Kwords
3. 1 Kword
4. 2 Kwords
5. 4 Kwords
6. 8 Kwords
7. 16 Kwords
8. 32 Kwords

③ Memory Size Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The relationship between the memory volume and the recording time depends upon the sampling time established in the memory function setting (see Table 1).

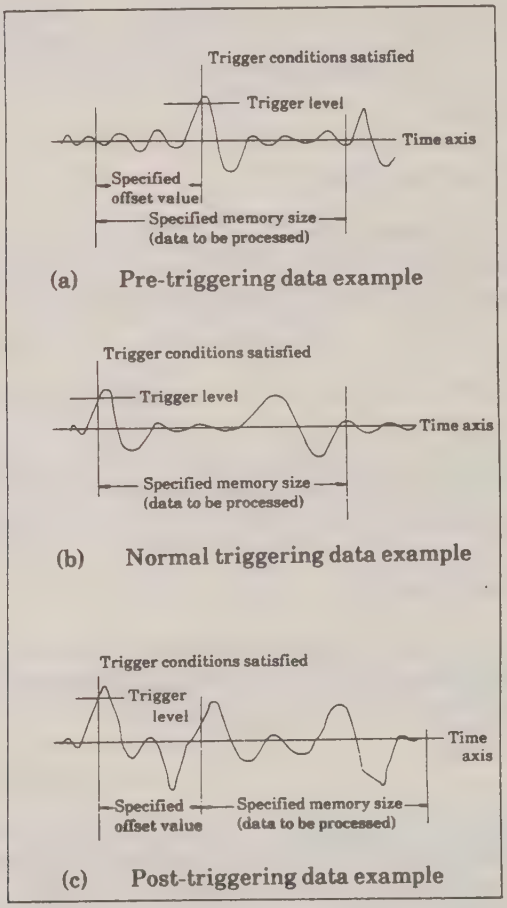


Fig. 2-29

2.3.14 Sampling Time Setting

If the SHIFT key is pressed simultaneously with the SMPL (T) key, the sampling time setting menu is displayed (Fig. 2.-30).

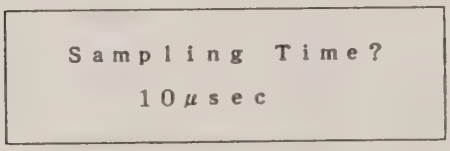


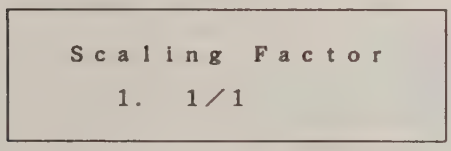
Fig. 2-30

10 μs,	20 μs
50 μs,	100 μs
200 μs,	500 μs
1 ms,	2 ms
5 ms,	10 ms
20 ms,	50 ms
100 ms,	200 ms
500 ms	External

The cursor keys are used to set the sampling time. If External is specified, data is sampled in synchronization with an external sampling clock. The maximum clock frequency is 100 kHz.

2.3.15 Memory Output Setting

If the SHIFT key is pressed simultaneously with the OUT (U) key, the scaling factor setting menu is displayed (Fig. 2-31).



1. 1/1
2. 1/2
3. 1/4
4. 1/8

Fig. 2-31

① Scaling Factor Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting.

The screen will change to the output memory area setting menu (Fig. 2-32).

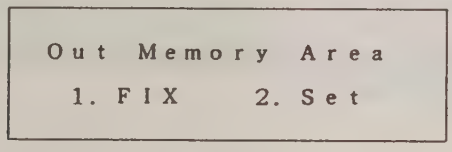


Fig. 2-32

For example, if the scaling factor is set to 1/2, for Y-T recording, the T axis will be compressed by 1/2. For X-Y recording, this setting is invalid.

② Output Memory Area Setting (1)

Use the cursor keys to move the blinking cursor to the position to be selected and press the ENTER key to make the setting.

If FIX is specified as the output memory area, all of the data specified by the memory volume will be recorded. If Set is specified, the menu shown in Fig. 2-33 is displayed and only data from a specified area in the memory volume will be stored in RAM and used as data.

Left value: 0 to 99

Right value: 1 to 100

Fig. 2-33

③ Output Memory Area Setting (2)

Set the value using numeric keys and press the ENTER key to make the setting. However, the right-side value must be set to a value larger than the left-side value.

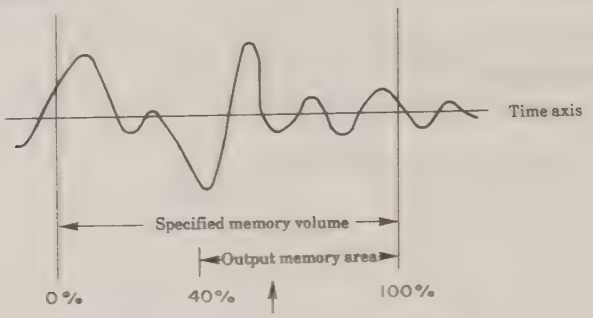


Fig. 3-34 Output Memory Area Data Example

Note

The memory output area setting is only valid when the MEMORY SAVE specification has been made. It is not possible to change the output area after specifying MEMORY OUT.

2.4 Direct X-Y Mode Operation

2.4.1 Mode Selection

With the WR3600 in the STOP condition, press the REC. MODE key so that the DIRECT LED lights (Fig. 2-35).

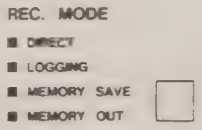


Fig. 2-35

2.4.2 Recording Format Setting

Press the SHIFT and the RECFMAT (F) keys simultaneously to display the recording format setting menu (Fig. 2-36).

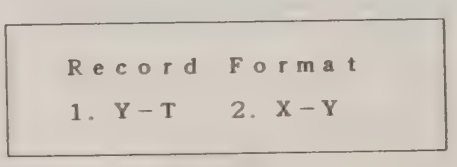


Fig. 2-36

① Recording Format Setting

Use the cursor keys to move the blinking cursor to the X-Y position and press the ENTER key to make the setting. The screen will change to the X-axis setting screen (Fig. 2-37).

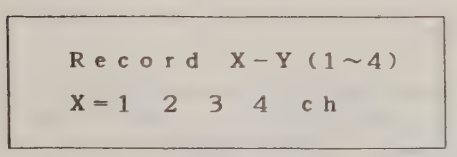


Fig. 2-37

② X-Axis Setting

Set the channel of channels 1 through 4 corresponding to the X axis. Use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. The screen will change to the Y1-axis setting menu (Fig. 2-38).

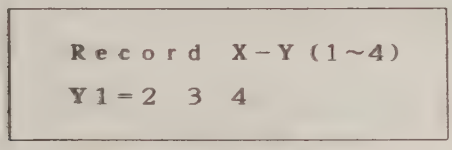


Fig. 2-38

③ Y1-Axis Setting

In the case of Fig. 2-38, the channel corresponding to the Y1 axis is selected from channels 2 to 4. Note that the channel selected as the X axis is not displayed in this menu. The cursor keys are used to move the blinking cursor to the desired position and the ENTER key is pressed to make the entry. At that point, the screen changes to the Y2-axis setting menu (Fig. 2-39).

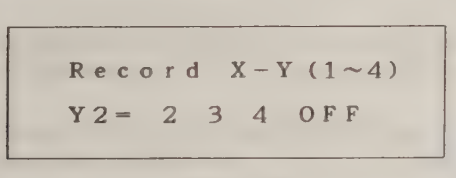


Fig. 2-39

④ Y2-Axis Setting

After the Y1-axis setting is completed, the Y2-axis setting menu appears. In this menu, it possible to make the OFF setting. By setting to OFF those axes on which recording is not possible, recording can be inhibited. Use the cursor keys to move the blinking cursor to the desired item and press the ENTER key to make the setting. At that point, the screen changes to the Y3-axis setting menu (Fig. 2-40).

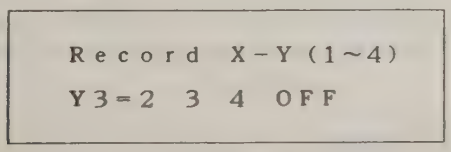


Fig. 2-40

⑤ Y3-Axis Setting

After the Y2-axis setting is completed, the Y3-axis setting menu appears. In this menu, it possible to make the OFF setting. By setting to OFF those axes on which recording is not possible, recording can be inhibited. Use the cursor keys to move the blinking cursor to the desired item and press the ENTER key to make the setting. For recording, see Recording Example 2.

Note

If the recording format is specified as X-Y, recording is divided into the two groups of channels, 1 through 4 and channels 5 through 8. After making settings for the channel 1 through channel 4 group, settings are required for the channel 5 through channel 8 group. The settings for the latter group are the same as for the former group (i.e., steps ① through ⑤ are performed twice). The screen then changes to the list print setting menu (Fig. 2-41).

Fig. 2-41

⑥ List Printing Setting

Use the cursor keys to move the blinking cursor to the desired item to be selected and press the ENTER key to make the setting.

If the list print is set to Yes, the list will start as follows.

① For roll paper: List printing is started immediately when the recording is stopped.

② Z-fold paper: After recording stops, list printing is performed after a page feed.

For list recording, refer to Recording Example 1.

2.4.3 Polarity Reverse Setting

If the SHIFT key is pressed simultaneously with the POLREV (N) key, the polarity switching setting menu is displayed (Fig. 2-42).

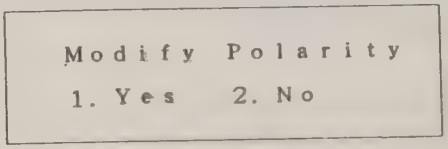


Fig. 2-42

① Modify Polarity Setting

With the display as shown in Fig. 2-42, use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "yes" is set, the screen used to set the polarity of channels 1 to 8 is displayed (Fig. 2-43).

Fig. 2-43

② Individual Channel Polarity Settings

Use the cursor key to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "Posi" is input, the polarity of the input voltage does not change. If "Nega" is input, the input voltage is switched in polarity, so that a +1 V input will be processed internally as a −1 V input. The setting is made by the cursor keys or numeric keys and stops when all 8 channels have been set.

2.5 Logging Mode Operation

The WR3600 can be used as follows in the logging mode.

2.5.1 Mode Selection

With the WR3600 in the STOP condition, press the REC MODE key so that the LOGGING LED lights (Fig. 2-44).

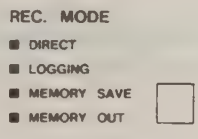


Fig. 2-44

2.5.2 Data Scale Function Setting

Press the SHIFT key and the DATASCALE (V) key simultaneously to display the logging scale setting menu (Fig. 2-45).

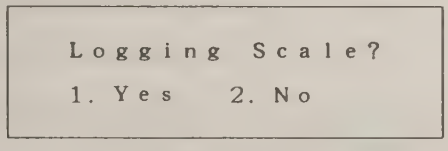
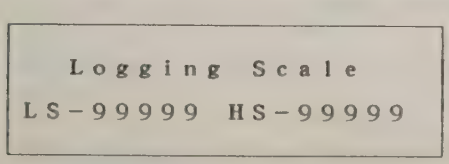


Fig. 2-45

① Logging Scale Setting

Use the cursor key to move the blinking cursor to the item to be selected and press the ENTER key to make the setting. If "yes" is selected, the screen changes to the logging scale value setting (Fig. 2-46).



LS: Lower-limit value for the input range
US: Upper-limit value for the input range

Fig. 2-46

If "no" is selected, the logging interval setting screen appears (Fig. 2-47).

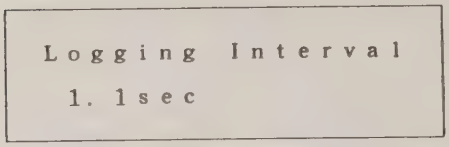


Fig. 2-47

② Logging Scale Value Setting

The scale values can be input in the range −99999 to +99999. However, a decimal point may not be input.

Setting Conditions

Input range:	±10 V/FS
LS	−10000
HS	10000

With the above conditions set, for an input of +5 V, the logging value would be 5000.

When the logging scale value is set, the display changes to the logging interval setting screen(Fig. 2-47).

③ Logging Interval Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. For recording, see Recording Example 5.

2.6 Memory Y-T Mode Operation

The WR3600 can be operated in the following manner to perform memory Y-T mode recording.

2.6.1 Mode Selection

With the WR3600 in the STOP condition press the REC MODE key so that the MEMORY SAVE LED lights (Fig. 2-48).

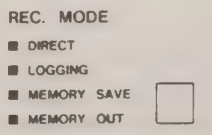


Fig. 2-48

2.6.2 Recording Format Setting

Press the SHIFT key simultaneously with the RECFMAT (F) key to display the recording format setting menu (Fig. 2-49).

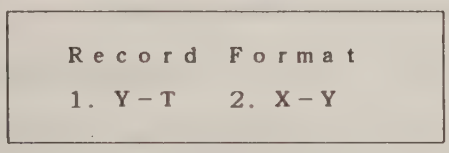


Fig. 2-49

① Recording Format Setting

Use the cursor keys to move the blinking cursor key to the Y-T position and press the ENTER key to make the setting. The screen will change to the recording width setting menu (Fig. 2-50).

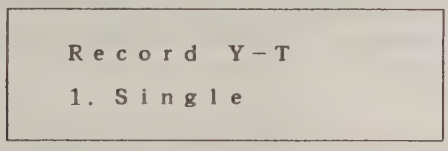


Fig. 2-50

② Recording Width Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The screen will change to the list print setting (Fig. 2-51).

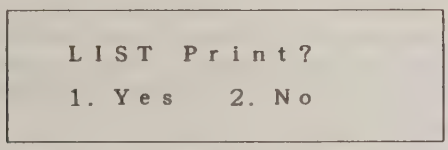


Fig. 2-51

1. Single (40 mm width)

2. Double (80 mm width)

3. Wide (160 mm width)

For recording, refer to Recording Example 6.

③ List Print Setting

Use the cursor keys to move the blinking cursor to the item to be selected and press the ENTER key to make the setting.

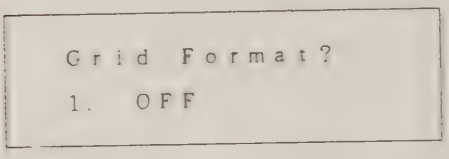
If Yes was set, the list will begin as follows.

For roll paper: List printing is performed immediately after recording is stopped.

For Z-fold paper: List printing is performed after recording is stopped and a page feed is performed.

2.6.3 Grid Setting

If the SHIFT key and GRID (G) key are pressed simultaneously, the GRID format setting menu is displayed (Fig. 2-52).



1: OFF

2: 10 mm × 10 mm

3: 5 mm × 5 mm

4: 5 mm × 4 mm

Fig. 2-52

① GRID Format Setting

Use the cursor keys or the numeric keys to make the setting. If the GRID Format setting is selected as OFF the GRID function setting is terminated. If a value in the range 2 to 4 is selected from the GRID format menu setting, the fine grid setting menu is displayed (Fig 2-53).

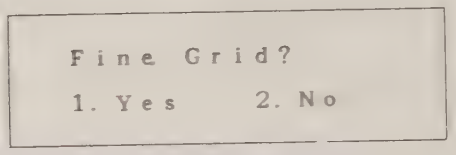


Fig. 2-53

② Fine Grid Setting

Settings can be made with the cursor keys or with the numeric keys. Press the ENTER key to make the setting. If the fine grid "Yes" setting is made, fine grids with an interval of 1 mm are printed between other grid lines. Refer to Recording Example 3 for the grid format.

2.6.4 Polarity Reverse Setting

If the SHIFT key is pressed simultaneously with the POLREV (N) key, the polarity switching setting menu is displayed (Fig. 2-54).

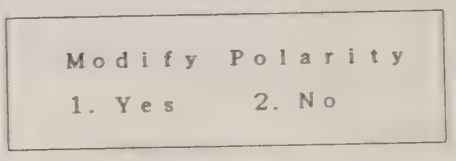


Fig. 2-54

① Modify Polarity Setting

With the display as shown in Fig. 2-54, use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "yes" is set, the screen used to set the polarity of channels 1 to 8 is displayed (Fig. 2-55).

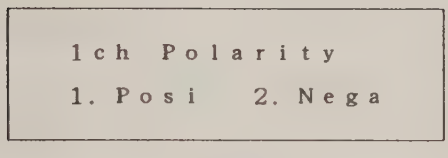


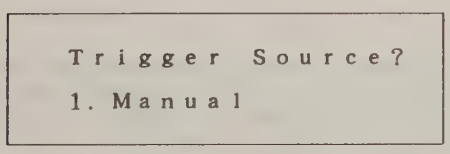
Fig. 2-55

② Individual Channel Polarity Settings

Use the cursor key to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "Posi" is input, the polarity of the input voltage does not change. If "Nega" is input, the input voltage is switched in polarity, so that a +1 V input will be processed internally as a −1 V input. The setting is made by the cursor keys or numeric keys and stops when all 8 channels have been set.

2.6.5 Trigger Source Setting

If the SHIFT key is pressed simultaneously with the SRCE (Q) key, the trigger source setting menu is displayed (Fig. 2-56).



1. Manual
2. Internal
3. External

Fig. 2-56

The setting can be made with cursor keys or with numeric keys. The operation is described below.

1. Manual

When the START key is pressed once, recording is started (direct recording).

When the START key is pressed twice, recording is started (memory recording).

2. Internal

When the input conditions for the channel on which the trigger level is set are satisfied, recording begins.

3. External

When a trigger start signal is input at the remote connector, recording begins. (This is a TTL low-level input or a short to the GND terminal.)

2.6.6 Trigger Level Setting

If the SHIFT key is pressed simultaneously with the LEVEL (R) key, the trigger level menu setting is displayed (Fig. 2-57). This is only valid, however, if the trigger source was set to internal.

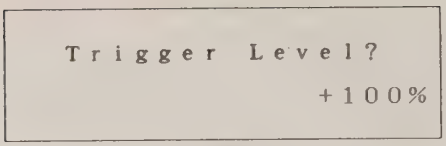


Fig. 2-57

① Trigger Level Setting

The trigger level can be set in the range −100% (lower voltage limit of input range) to +100% (upper voltage limit of input range). The setting is made using numeric keys, and when the ENTER key is pressed, the screen changes to the trigger channel setting screen (Fig. 2-58).

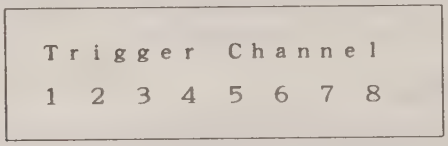


Fig. 2-58

② Trigger Channel Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting. The trigger channel is selected as one channel of channels 1 through 8. When this is done, the screen changes to the trigger slope setting display (Fig. 2-59).

Fig. 2-59

③ Trigger Slope Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting.

The trigger slope can be set to rising edge ( ) or falling edge ( ) of the input signal (Fig. 2-60).

Trigger Level Example

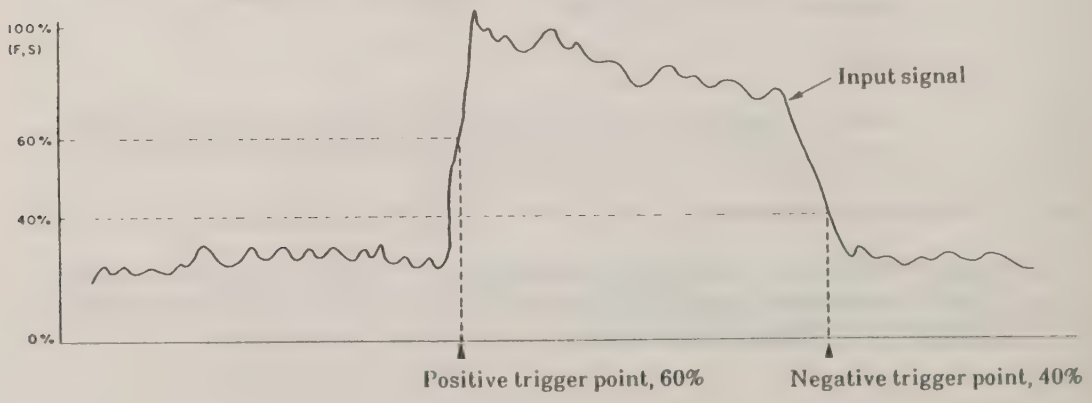


Fig. 2-60 (Input Range: ±10 V Full Scale)

2.6.7 Trigger Function Setting

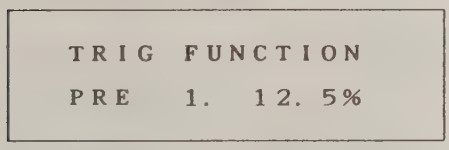
If the SHIFT key is pressed simultaneously with the PRE (S) key, the trigger function setting menu is displayed. Settings are made using the cursor or the numeric keys (Fig. 2-61).

1. Normal
2. Pre
3. Post

Fig. 2-61

① Trigger Function Setting

Use the cursor keys to display the desired item and press the ENTER key to make the setting. If the normal setting function had been made, the screen will change to the trigger offset setting menu (Fig. 2-62).



1. 12.5%
2. 25 %
3. 50 %
4. 100 %

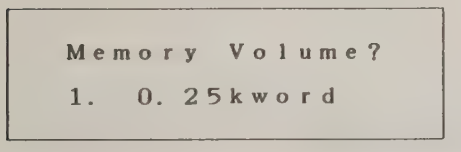
Fig. 2-62

② Trigger Offset Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The screen will change to the memory size setting menu (Fig. 2-63).

Note

The pre-trigger or post-trigger setting is valid only for memory recording. If a direct recording mode has been selected, even if pre-triggering is set, the recorder will operate with normal triggering. To perform memory recording, it is necessary to make the memory function setting.



1. 0.25 Kwords
2. 0.5 Kwords
3. 1 Kword
4. 2 Kwords
5. 4 Kwords
6. 8 Kwords
7. 16 Kwords
8. 32 Kwords

Fig. 2-63

③ Memory Size Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The relationship between the memory volume and the recording time depends upon the sampling time established in the memory function setting (see Table 1).

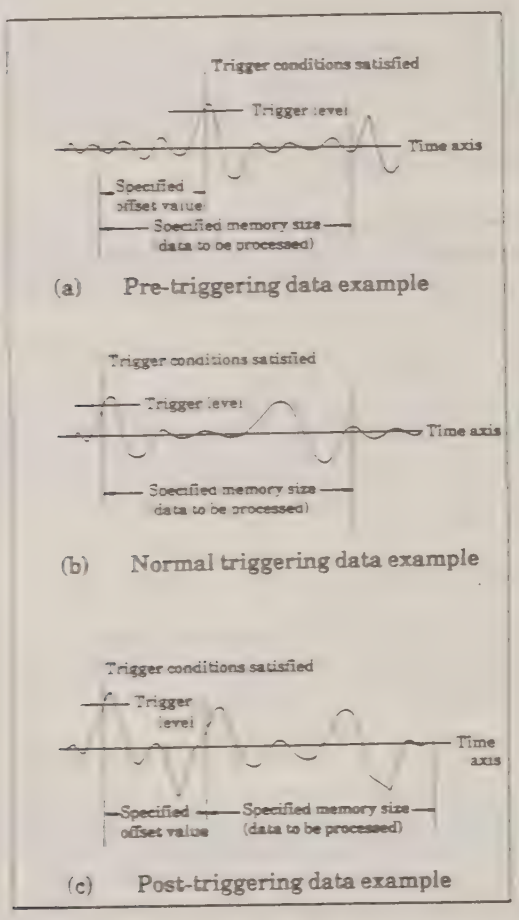


Fig. 2-64

2.6.8 Sampling Time Setting

If the SHIFT key is pressed simultaneously with the SMPL (T) key, the sampling time setting menu is displayed (Fig. 2-65).

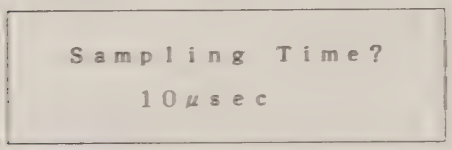


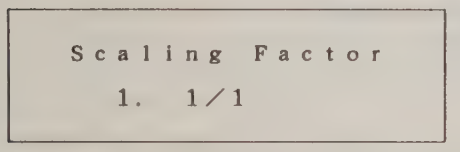
Fig. 2-65

10 μs,	20 μs
50 μs,	100 μs
200 μs,	500 μs
1 ms,	2 ms
5 ms,	10 ms
20 ms,	50 ms
100 ms,	200 ms
500 ms	External

The cursor keys are used to set the sampling time. If External is specified, data is sampled in synchronization with an external sampling clock. The maximum clock frequency is 100 kHz.

2.6.9 Memory Output Setting

If the SHIFT key is pressed simultaneously with the OUT (U) key, the scaling factor setting menu is displayed (Fig. 2-66).



1. 1/1
2. 1/2
3. 1/4
4. 1/8

Fig. 2-66

① Scaling Factor Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting.

The screen will change to the output memory area setting menu (Fig. 2-67).

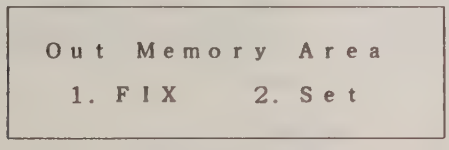


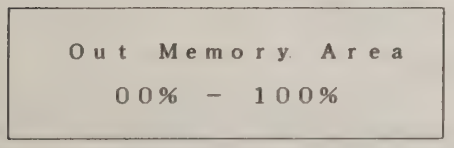
Fig. 2-67

For example, if the scaling factor is set to 1/2, for Y-T recording, the T axis will be compressed by 1/2. For X-Y recording, this setting is invalid.

② Output Memory Area Setting (1)

Use the cursor keys to move the blinking cursor to the position to be selected and press the ENTER key to make the setting.

If FIX is specified as the output memory area, all of the data specified by the memory volume will be recorded. If Set is specified, the menu shown in Fig. 2-68 is displayed and only data from a specified area in the memory volume will be stored in RAM and used as data.



Left value: 0 to 99

Right value: 1 to 100

Fig. 2-68

③ Output Memory Area Setting (2)

Set the value using numeric keys and press the ENTER key to make the setting. However, the right-side value must be set to a value larger than the left-side value.

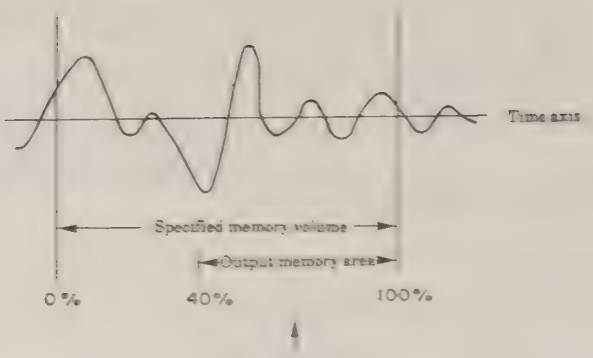


Fig. 2-69 Output Memory Area Data Example

After the above setting is made, when the START key is pressed, recording starts when trigger conditions are satisfied

2.7 Memory X-Y Mode Operation (Option)

2.7.1 Mode Selection

With the WR3600 in the STOP condition, press the REC MODE key so that the MEMORY SAVE LED lights (Fig. 2-70).

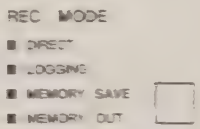


Fig. 2-70

2.7.2 Recording Format Setting

Press the SHIFT and the RECFMAT (F) keys simultaneously to display the recording format setting menu (Fig. 2-71).

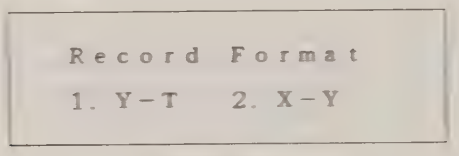


Fig. 2-71

① Recording Format Setting

Use the cursor keys to move the blinking cursor to the X-Y position and press the ENTER key to make the setting. The screen will change to the X-axis setting screen (Fig. 2-72).

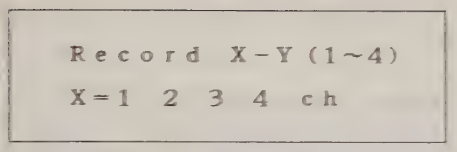


Fig. 2-72

② X-Axis Setting

Set the channel of channels 1 through 4 corresponding to the X axis. Use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. The screen will change to the Y1-axis setting menu (Fig. 2-73).

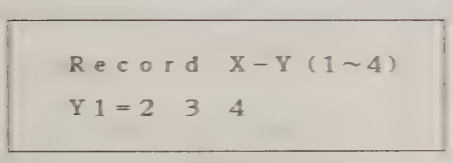


Fig. 2-73

③ Y1-Axis Setting

In the case of Fig. 2-73, the channel corresponding to the Y1 axis is selected from channels 2 to 4. Note that the channel selected as the X axis is not displayed in this menu. The cursor keys are used to move the blinking cursor to the desired position and the ENTER key is pressed to make the entry. At that point, the screen changes to the Y2-axis setting menu (Fig. 2-74).

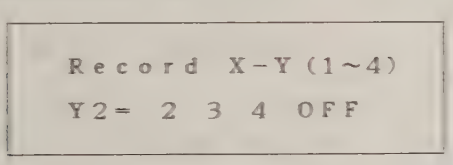


Fig. 2-74

④ Y2-Axis Setting

After the Y1-axis setting is completed, the Y2-axis setting menu appears. In this menu, it possible to make the OFF setting. By setting to OFF those axes on which recording is not possible, recording can be inhibited. Use the cursor keys to move the blinking cursor to the desired item and press the ENTER key to make the setting. At that point, the screen changes to the Y3-axis setting menu (Fig. 2-75).

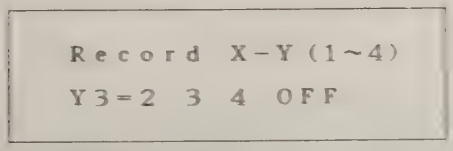


Fig. 2-75

⑤ Y3-Axis Setting

After the Y2-axis setting is completed, the Y3-axis setting menu appears. In this menu, it possible to make the OFF setting. By setting to OFF those axes on which recording is not possible, recording can be inhibited. Use the cursor keys to move the blinking cursor to the desired item and press the ENTER key to make the setting.

Note

If the recording format is specified as X-Y, recording is divided into the two groups of channels, 1 through 4 and channels 5 through 8. After making settings for the channel 1 through channel 4 group, settings are required for the channel 5 through channel 8 group. The settings for the latter group are the same as for the former group (i.e., steps ① through ⑤ are performed twice). The screen then changes to the list print setting menu (Fig. 2-76).

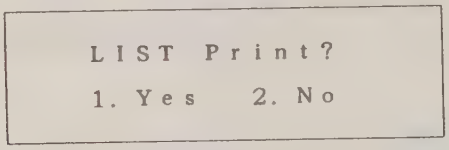


Fig. 2-76

⑥ List Printing Setting

Use the cursor keys to move the blinking cursor to the desired item to be selected and press the ENTER key to make the setting.

If the list print is set to Yes, the list will start as follows.

① For roll paper: List printing is started immediately when the recording is stopped.

② Z-fold paper: After recording stops, list printing is performed after a page feed.

2.7.3 Polarity Reverse Setting

If the SHIFT key is pressed simultaneously with the POLREV (N) key, the polarity switching setting menu is displayed (Fig. 2-77).

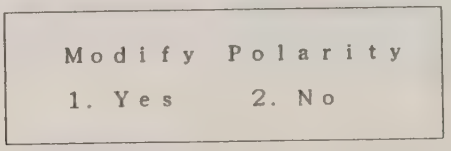


Fig. 2-77

① Modify Polarity Setting

With the display as shown in Fig. 2-77, use the cursor keys to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "yes" is set, the screen used to set the polarity of channels 1 to 8 is displayed (Fig. 2-78).

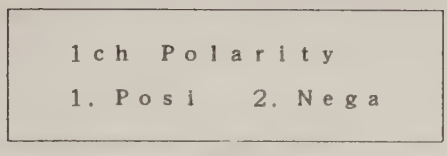


Fig. 2-78

② Individual Channel Polarity Settings

Use the cursor key to move the blinking cursor to the desired position and press the ENTER key to make the setting. If "Posi" is input, the polarity of the input voltage does not change. If "Nega" is input, the input voltage is switched in polarity, so that a +1 V input will be processed internally as a −1 V input. The setting is made by the cursor keys or numeric keys and stops when all 8 channels have been set.

2.7.4 Trigger Source Setting

If the SHIFT key is pressed simultaneously with the SRCE (Q) key, the trigger source setting menu is displayed (Fig. 2-79).

1. Manual
2. Internal
3. External

Fig. 2-79

The setting can be made with cursor keys or with numeric keys. The operation is described below.

1. Manual

   When the START key is pressed once, recording is started (direct recording).

   When the START key is pressed twice, recording is started (memory recording).

2. Internal

   When the input conditions for the channel on which the trigger level is set are satisfied, recording begins.

3. External

   When a trigger start signal is input at the remote connector, recording begins. (This is a TTL low-level input or a short to the GND terminal.)

2.7.5 Trigger Level Setting

If the SHIFT key is pressed simultaneously with the LEVEL (R) key, the trigger level menu setting is displayed (Fig. 2-80). This is only valid, however, if the trigger source was set to internal.

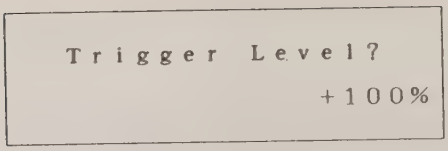


Fig. 2-80

① Trigger Level Setting

The trigger level can be set in the range −100% (lower voltage limit of input range) to +100% (upper voltage limit of input range). The setting is made using numeric keys, and when the ENTER key is pressed, the screen changes to the trigger channel setting screen (Fig. 2-81).

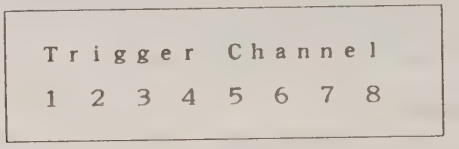


Fig. 2-81

② Trigger Channel Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting. The trigger channel is selected as one channel of channels 1 through 8. When this is done, the screen changes to the trigger slope setting display (Fig. 2-82).

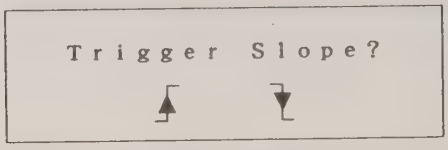


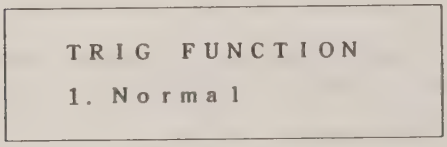
Fig. 2-82

③ Trigger Slope Setting

Use the cursor keys to move the blinking cursor to the desired position, and press the ENTER key to make the setting.

2.7.6 Trigger Function Setting

If the SHIFT key is pressed simultaneously with the PRE (S) key, the trigger function setting menu is displayed. Settings are made using the cursor or the numeric keys (Fig. 2-83).



1. Normal
2. Pre
3. Post

Fig. 2-83

① Trigger Function Setting

Use the cursor keys to display the desired item and press the ENTER key to make the setting. If the normal setting function had been made, the screen will change to the trigger offset setting menu (Fig. 2-84).

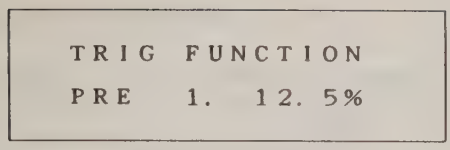


Fig. 2-84

1. 12.5%
2. 25 %
3. 50 %
4. 100 %

② Trigger Offset Setting

Use the cursor keys to display the item to be selected and press the ENTER to make the setting. The screen will change to the memory size setting menu (Fig. 2-85).

Note

The pre-trigger or post-trigger setting is valid only for memory recording. If a direct recording mode has been selected, even if pre-triggering is set, the recorder will operate with normal triggering. To perform memory recording, it is necessary to make the memory function setting. For direct Y-T recording, and the setting of Trg-Memory, settings of ② and below are valid.

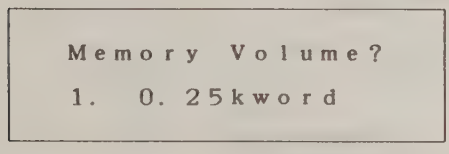


Fig. 2-85

1. 0.25 Kwords
2. 0.5 Kwords
3. 1 Kword
4. 2 Kwords
5. 4 Kwords
6. 8 Kwords
7. 16 Kwords
8. 32 Kwords

③ Memory Size Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting. The relationship between the memory volume and the recording time depends upon the sampling time established in the memory function setting (see Table 1).

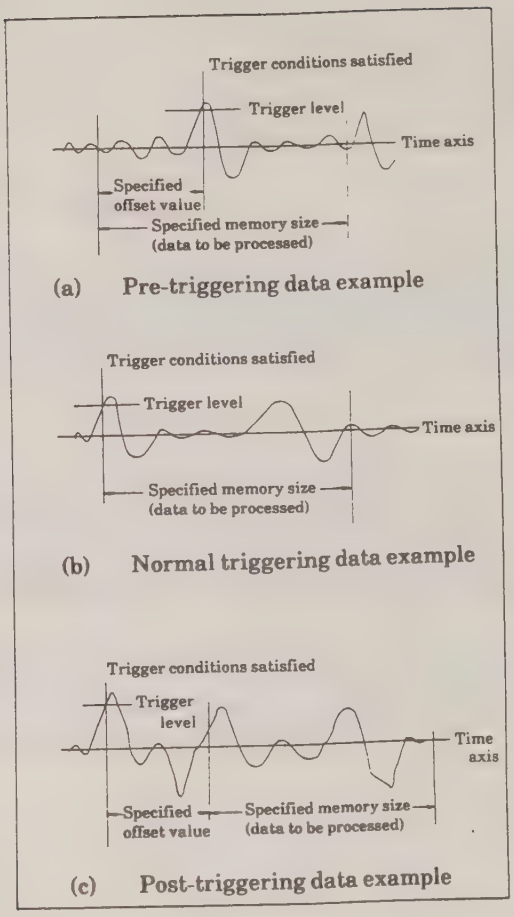
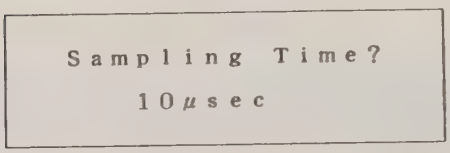


Fig. 2-86

2.7.7 Sampling Time Setting

If the SHIFT key is pressed simultaneously with the SMPL (T) key, the sampling time setting menu is displayed (Fig. 2.-87).



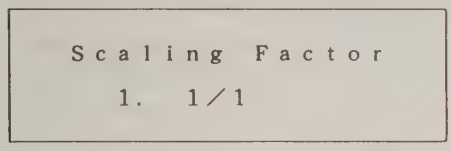
10 μs,	20 μs
50 μs,	100 μs
200 μs,	500 μs
1 ms,	2 ms
5 ms,	10 ms
20 ms,	50 ms
100 ms,	200 ms
500 ms	External

Fig. 2-87

The cursor keys are used to set the sampling time. If External is specified, data is sampled in synchronization with an external sampling clock. The maximum clock frequency is 100 kHz.

2.7.8 Memory Output Setting

If the SHIFT key is pressed simultaneously with the OUT (U) key, the scaling factor setting menu is displayed (Fig. 2-88).



1. 1/1
2. 1/2
3. 1/4
4. 1/8

Fig. 2-88

① Scaling Factor Setting

Use the cursor keys to display the item to be selected and press the ENTER key to make the setting.

The screen will change to the output memory area setting menu (Fig. 2-89).

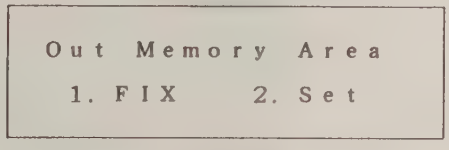


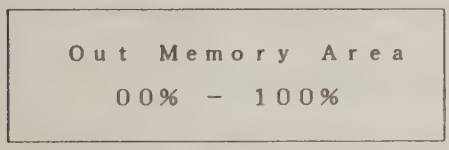
Fig. 2-89

For example, if the scaling factor is set to 1/2, for Y-T recording, the T axis will be compressed by 1/2. For X-Y recording, this setting is invalid.

② Output Memory Area Setting (1)

Use the cursor keys to move the blinking cursor to the position to be selected and press the ENTER key to make the setting.

If FIX is specified as the output memory area, all of the data specified by the memory volume will be recorded. If Set is specified, the menu shown in Fig. 2-90 is displayed and only data from a specified area in the memory volume will be stored in RAM and used as data.



Left value: 0 to 99

Right value: 1 to 100

Fig. 2-90

③ Output Memory Area Setting (2)

Set the value using numeric keys and press the ENTER key to make the setting. However, the right-side value must be set to a value larger than the left-side value.

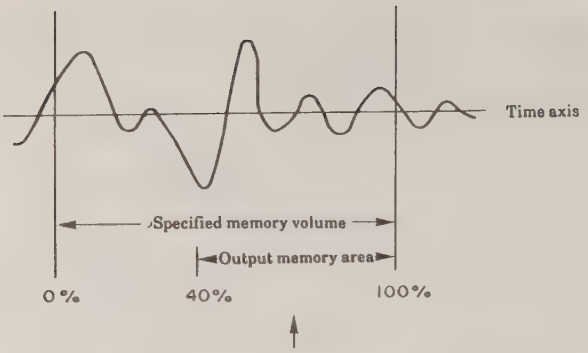


Fig. 2-91 Output Memory Area Data Example

After the above setting is made, when the START key is pressed, recording starts when trigger conditions are satisfied.

3. INTERFACE OPERATION

3.1 RS-232C Interface

3.1.1 Interface Cable

In transferring data via the RS-232C interface, an RS-232C cable with the cross-connections as shown in Fig. 3-2 is used (for example, the Graphtec CA4631-52 shown in Fig. 3-1).

Fig. 3-1 CA4631-52 Cable

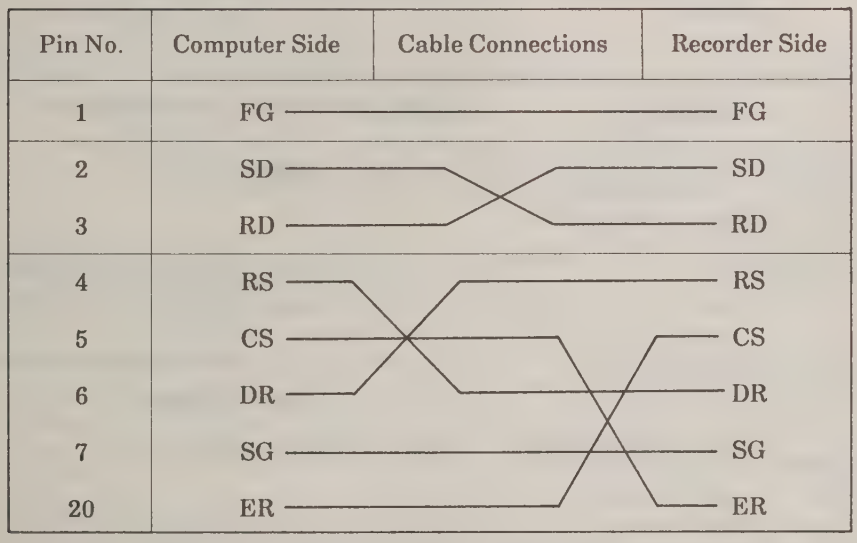


Fig. 3-2 Cable Connections

3.1.2 RS-232C Interface Description

The RS-232C connector of the WR3600, as shown in Fig. 3-5, has the send signal SD, receive signal RD, and status signals RS, CS, ER, and DR connected to various pins. For data transmission, the WR3600 operates as a DTE (data terminal equipment). The normal personal computer has the same type of connector and is set up to operate as a DTE as well. This is done to enable a modem (modulator-demodulator) to be inserted between each piece of equipment for remote transmission over telephone lines. Therefore, in making direct connections to the computer from the recorder without going through a modem, the computer must operate as a DCE (data centralized terminal equipment). To achieve this, SD-RD, ER-CS, and RS-DR cross connections are made as shown in Fig. 3-2, using, for example, a CA4631-52 cable.

Notes

1. Commercially available RS-232C cables do not have the above-mentioned cross-connections. When using this type of cable to make direct connection without using a modem, the cross connections shown in Fig. 3-2 must be made. Graphtec has available cables for use with a variety of computers. S1 switch settings must be made for the conditions listed in Table 3-1.

2. In general, RS-232C data handshaking is performed according to the protocols described in Fig. 3-3. In the case of the WR3600, when making connections to a computer, the computer operates as a DCE and the WR3600 operates as a DTE in transferring data by the same type of protocol.

	DTE (WR3600)	Signal Line	DCE (Computer)
1	RS is set to on, indicating to the DCE that data to be sent exists.	→RS→	Wait for RS.
2	Wait for CS.	←CS←	CS is set to on, indicating that input is possible.
3	Required data is sent.	→SD→	Data is received and stored in an internal register.
4	RS is set to off, indicating the end of data.	→$\overline{\text{RS}}$→	Wait until RS is set to off.
5	Wait for CS to be set to off.	←$\overline{\text{CS}}$←	Set CS to off and return to 1.

(a) Data Transmission from DTE to DCE

	DTE (WR3600)	Signal Line	DCE (Computer)
1	Set ER on, indicating that input is possible.	→ER→	Wait for ER.
2	Wait for DR.	←DR←	Set DR to on, indicating that data to be output exists.
3	Receive data.	←RD←	Send the required data.
4	Wait for DR to be set to off.	←$\overline{\text{DR}}$←	Set DR to off, indicating the end of data.
5	If required, set ER to off and return to 1.	→$\overline{\text{ER}}$→	

(b) Data Transmission from DCE to DTE

Fig. 3-3 RS-232C Handshaking

Notes

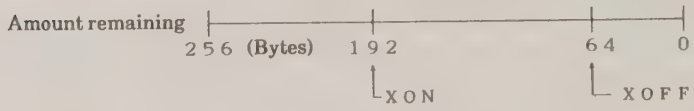
1. In transmission from the DTE to the DCE, if data transmission is not possible, the CS is set to off and the sequence returns to 1 (i.e., sending is interrupted).

2. If CS is on before RS is set to on, the SD signal is sent normally and an error condition does not occur.

3. RS-232C signal names are assigned differently by the four different standards JIS, old JIS, ASCII and TTICC (see table below).

Pin No.	TTICC V.24	JIS		ASCII	Signal Description
		New	OLD		
1	101	FG	FG	AA	Protective ground
2	103	SD	TXD	BA	Send data
3	104	RD	RXD	BB	Receive data
4	105	RS	RTS	CA	Request to send
5	106	CS	CTS	CB	Clear to send
6	107	DR	DSR	CC	Ready to send data
7	102	SG	SG	AB	Signal ground
8	109	CD	CD	CF	Carrier detection
20	108/2	ER	DTR	CD	Ready to receive

4. Bit 9 of DIP switch S1 is set to 0 to perform X on/off control, and is set to 1 for normal handshaking. When set to 0, the ER and RS signals are held at 0, and X on uses DC1 (11_{16}) and Xoff uses DC3 (13_{16}) to inform the other end of remaining buffer size, as shown below.



5. Bit 10 of switch S1 establishes whether or not the RS signal is to be held on. When it is set to 0, RS is held in the on condition.

RS-232C Interface

For the RS-232C interface, the connector signal names, transmission speeds, and format settings are shown in Table 3-1, with the method of connection and handshake protocols shown in Fig. 3-3. This section will provide a general description of the interface.

① General Specifications

Transmission method	Half duplex, start/stop
Transmission functions	X parameter handshaking functions, RS can be held in ON condition (switch selectable).
Transmission rate	75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200 baud (switch selected)
Number of stop bits	1, 1.5, or 2 (switch selected)
Parity	Odd, even, or none (switch selected)
Data length	7 or 8 bits (see data format in Fig. 3-4)

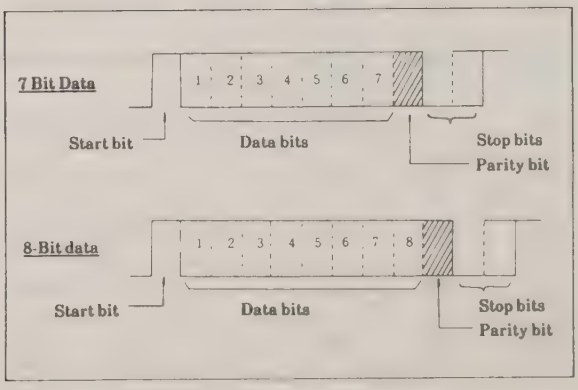


Fig. 3-4 Data Length

② Signal Electrical Characteristics

Negative logic is used for the send and receive data signals RD and SD. The voltage reference levels are given in Fig. 3-5.

③ Circuit (See Fig. 3-6)

④ Recorder side connector: DB-25P or equivalent

		RD, SD (Negative logic)	RS, CS, DR, ER (Positive logic)
Input voltage level	+5 to +12 V	Logic 0	ON
	−5 to −12 V	Logic 1	OFF
Output voltage level	+10 V typ.	Logic 0	ON
	−10 V typ.	Logic 1	OFF
Load impedance	3 to 7 kΩ	Logic 1	

Fig. 3-5 Signal Electrical Characteristics

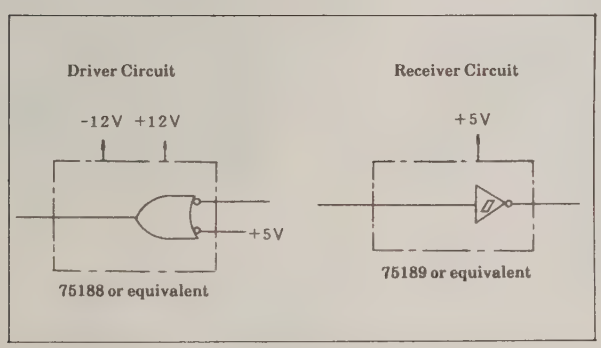


Fig. 3-6 Input/Output Signal Circuits

3.1.3 RS-232C Interface Connector Table

Equipment which uses the RS-232C interface for data transfer has a rear-panel RS-232C interface panel as shown in Fig. 3-7. This panel is described below.

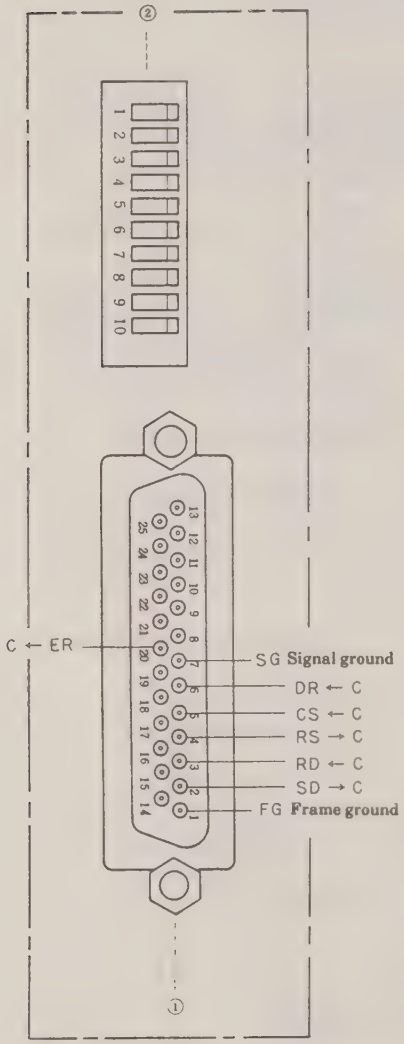


Fig. 3-7

① RS-232C Connector: This connector conforms to EIA RS-232C, JIS C6361, or CCITT V.24 standards or recommendations, and has the signal arrangement as shown in Fig. 3-7. The signal names indicated in this figure conform to JIS C6361 specifications, with "→C" indicating outputs to an external device, and "←C" indicating signals received from an external device (C: computer).

② Switch S1: This switch is used to set the number of stop bits, parity, bit length, X on/Xoff handshaking, and RS-ON condition.

Notes

1. X on/Xoff handshaking uses special characters to control data transfer. When this is used, the on/off conditions of status signals are ignored.

2. RS-ON refers to the condition in which the RS signal is held in the on condition.

3.1.4 Function Setting Switch S1

BIT No.	1 2	3 4	5	6 7 8	9	10
Setting	Stop bit(s)	Parity	Bit length	Baud rate	X O N – X O F F	RS Control

Settings

Switch 1	Switch 2	STOP
0	1	1 BIT
1	0	1 1/2 BIT
1	1	2 BIT

Switch 3	Switch 4	PARITY
0	0	NON
0	1	ODD
1	0	NON
1	1	EVEN

Switch 5	BIT LENGTH
0	7 BIT
1	8 BIT

Switch 6	Switch 7	Switch 8	BAUD RATE
1	1	1	19200
0	1	1	9600
1	0	1	4800
0	0	1	2400
1	1	0	1200
0	1	0	600
1	0	0	300
0	0	0	—

Switch 9	XON XOFF
0	X-ON X-OFF HAND SHAKE
1	HARD HAND SHAKE

Switch 10	RS
0	Always on
1	On only when sending

3.2 Data Transfer

3.2.1 Data Transfer Types

The WR3600 can perform the following types of transfer to an external computer using either a built-in GPIB interface or RS-232C interface.

- Main front panel or menu setting conditions
- Amplifier setting conditions
- Memory data captured in the memory mode

3.2.2 Basic Transfer Protocols

(a) Signal Cable Connections

For the RS-232C, a specially connected RS-232C cable (e.g., Graphtec type CA4631-52 cable) is used to make connections to the computer.

(b) Interface Switch Settings

For the RS-232C, refer to Table 3-1 for switch settings of conditions.

(c) Loading the Transfer Program

A transfer program for the particular computer to be used is generated and loaded.

(d) WR3600 Measurement Condition Settings

The WR3600 is placed in the measurement condition, and a data capture is tried to enable operating panel and menu settings to be made. Then the CONTROL switch is pressed to place the recorder in the REMOTE (interface) mode.

(e) WR3600 Measurement Start and Stop

In general, measurement is started and then the STOP key is pressed to stop the measurement after verifying that data has been captured.

(f) Running the Computer Program

The computer program is run to start the WR3600 measurement and data transfer sequence.

3.2.3 Commands

The control and transfer commands used in generating the program for the WR3600 are shown in the interface command table.

3.2.4 Transfer Data Format

Main operating panel and menu setting conditions and amplifier setting conditions are transferred in the form of strings of ASCII characters. Data stored in the memory mode is transferred as binary-coded data.

3.3 WR3600 Interface Command Table (1)

Command	Format	Contents of n and m, and applications	Output Data Format	
INITIAL	IN (T)	WR3600 Initialization		
MODE SET	MDn (T)	n = 1 : Direct 2 : Logging 3 : Memory save 4 : Memory output		
RECORD START	TG0 (T)	WR3600 Start recording		
RECORD STOP	TG1 (T)	WR3600 Stop recording		
FORM FEED	FF (T)	Chart paper feed form feed (page feed)		
LIST OUT	LI (T)	List output		
OUTPUT STATUS	OS (T)	Read Status Data	Format 4	
OUTPUT REPORT	ORn (T)	n = 1: Read operating panel setting conditions n = 2: Read 1 of amplifier setting conditions n = 3: Read 2 of amplifier setting conditions	Format 5 Format 2 Format 3	
OUTPUT IDENTITY	OI (T)	Read model name data		
EVENT LEFT ON/OFF	ELn (T)	n = 0: Set left event marker to off n = 1: Set left event marker to on		

WR3600 Interface Command Table (2)

Command	Format	Contents of n and m, and applications	Output Data Format	
EVENT RIGHT ON/OFF	ERn (T)	n = 0 : Set right event marker to off n = 1 : Set right event marker to on		
TIMER INTERVAL SET	TIn (T)	n = 0: off n = 1: 0.1 s n = 2: 1 s n = 3: 10 s n = 4: off n = 5: 0.1 min n = 6: 1 min n = 7: 10 min		
TIME-CODE/INTERNAL	TDn (T)	n = 0: Internal clock n = 1: IRIG Time code		
DATE SET	DSmmddyy (T)	mmddyy: mm = month dd = day yy = year		
TIME SET	TShhmmss (T)	hhmmss: hh = hour mm = minute ss = second		
PRINT REPEAT LENGTH	PLn (T)	n = 0: no repeat n = 1: each page n = 2: 100 mm n = 3: 200 mm n = 4: 300 mm n = 5: 400 mm n = 6: 500 mm		

WR3600 Interface Command Table (3)

Command	Format	Contents of n and m, and applications	Output Data Format	
PRINT FORMAT	PFabcd (T)	a = 0: No DATE printing b = 0: No TIME printing c = 0: No SPEED printing d = 0: No TIME SCALE printing a = 1: Print DATE b = 1: Print TIME c = 1: Print SPEED d = 1: Print TIME SCALE		
PRINT LABEL	LBnABC · · · (T)	n: Channel No. for printing (1-8) ABC · · ·: ASCII character string of up to 128 characters		
LABEL PRINT START	LP (T)	Start label printing		
PRINT TEXT	TXnnABC··· (T)	nn: Line number for printing (01-40, must be 2 digits) ABC: ASCII character string of up to 40 characters		
TEXT PRINT START	XP (T)	Start text printing		
CHART SPEED SET	CFssssst (T)	ssssss: 0.001 to 200.0 mm or 500.0 mm t = S : /s t = M : /min		

WR3600 Interface Command Table (4)

Command	Format	Contents of n and m, and applications	Output Data Format	
SAMPLING INTERVAL TIME	SInn (T)	nn = 00: 10 µs nn = 02: 50 µs nn = 04: 200 µs nn = 06: 1 ms nn = 08: 5 ms nn = 10: 20 ms nn = 12: 100 ms nn = 14: 500 ms nn = 01: 20 µs nn = 03: 100 µs nn = 05: 500 µs nn = 07: 2 ms nn = 09: 10 ms nn = 11: 50 ms nn = 13: 200 ms nn = 15: EXTERNAL		
TRIGGER SOURCE	TUn (T)	n = 0: MANUAL n = 1: INTERNAL n = 2: EXTERNAL		
TRIGGER CHANNEL	TCn (T)	n: Valid trigger channel (1-8)		
TRIGGER LEVEL	TLs ℓ ℓ (T)	S: Polarity (+ or −) ℓ ℓ: Level (00 to 50)		
TRIGGER SLOPE	TPn (T)	n = 0: n = 1:		

WR3600 Interface Command Table (5)

Command	Format	Contents of n and m, and applications	Output Data Format	
MEMORY VOLUME	MVn (T)	n = 0: 0.25 Kword n = 1: 0.5 Kword n = 2: 1 Kword n = 3: 2 Kwords n = 4: 4 Kwords n = 5: 8 Kwords n = 6: 16 Kwords n = 7: 32 Kwords		
TRIGGER FUNCTION	TFnm (T)	n = 0: Normal triggering n = 1: Pre-triggering n = 2: Post-triggering m = 0: 0% m = 1: 12.5% m = 2: 25% m = 3: 50% m = 4: 100%		
MEMORY OUTPUT AREA	MOsseee (T)	ss: Memory output starting % (00 to 99) eee: Memory output ending % (001 to 100)		
SCALING FACTOR	SCn (T)	n = 0: 1/1 n = 1: 1/2 n = 2: 1/4 n = 3: 1/8		
RECORD FORMAT	RFnm (T)	n = 0: Y-T format n = 1: X-Y format m = 0: No list printout m = 1: List printout		
Y-T FORMAT	YTn (T)	n = 0: Single n = 1: Double n = 2: Wide		

WR3600 Interface Command Table (6)

Command	Format	Contents of n and m, and applications	Output Data Format	
GRID TYPE	GRnm (T)	n = 0: off n = 1: 10 mm × 10 mm n = 2: 5 mm ×5 mm n = 3: 5 mm × 4 mm m = 0: No fine grid m = 1: Fine grid		
X-Y FORMAT	XYx1y1y2y3x2y4y 5y6 (T)	x1: Upper X-axis channel (1 to 4) y1: Upper Y1-axis channel (0 to 4) *0 is off y2: Upper Y2-axis channel (0 to 4) " y3: Upper Y3-axis channel (0 to 4) " x2: Lower X-axis channel (5 to 8) y4: Lower Y1-axis channel (0, 5 to 8) *0 is off y5: Lower Y2-axis channel (0, 5 to 8) " y6: Lower Y3-axis channel (0, 5 to 8) "		
BINARY DATA	BD ℓ, m, n (T)	ℓ: Readout channel specification (1 to 8) m: Data starting point (0 to 32767) n: Number of data (1 to 32768)	Format 1	
OUTPUT INTERVAL	OT n (T)	n = 0: 1 s n = 1: 10 s n = 2: 1 min n = 3: 10 min		

WR3600 Interface Command Table (7)

Command	Format	Contents of n and m, and applications	Output Data Format	
LOGGING SCALE FACTOR	LSn, m (T)	n: Low-side full scale (−99999 to +99998) m: High-side full scale (−99998 to +99999)		

3.4 Detailed Command Descriptions

When performing data transfer with the WR3600, 38 commands are used. These are described below in detail.

3.4.1 IN (Initialize) Command

This command places the WR3600 in the same condition as when power is first applied.

① Format

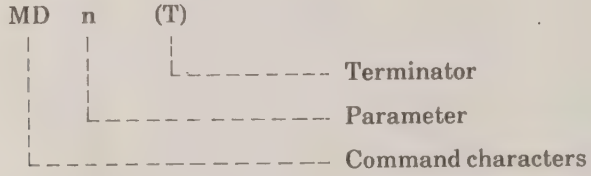
② Terminator: CR/LF

③ Valid conditions: Valid in either the START or the STOP condition.

3.4.2 MD (Mode Set) Command

This command is used to set the WR3600 operating mode.

① Format



② Parameter

n=1: Sets the WR3600 to the direct mode.

n=2: Sets the WR3600 to the logging mode.

n=3: Sets the WR3600 to the memory save mode.

n=4: Sets the WR3600 to the memory out mode.

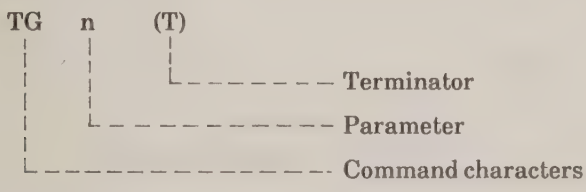
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.3 TG (Trigger) Command

This command is used in place of the START and STOP keys.

① Format



② Parameter

n=0: Sets the WR3600 to the START condition.

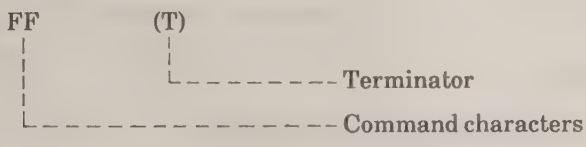
n=1: Sets the WR3600 to the STOP condition.

③ Terminator: CR/LF

3.4.4 FF (Form Feed) Command

This command is used to feed Z-fold paper to the next sensing mark and to feed roll paper approximately 300 mm.

① Format



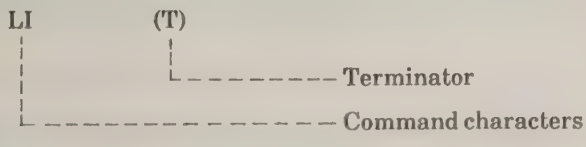
② Terminator: CR/LF

③ Valid conditions: Valid in the STOP condition.

3.4.5 LI (List Output) Command

This command is used to create a list output of setting conditions on the chart paper.

① Format



② Terminator: CR/LF

③ Valid conditions: Valid in the STOP condition.

3.4.6 OS (Output Status) Command

This command is used to read the output status signals. When this command is received, the internal conditions of the WR3600 are output as the status.

① Format

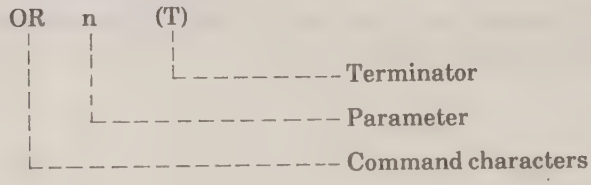
② Terminator: CR/LF

③ Refer to Output Data Format 4 for the data contents.

3.4.7 OR (Output Report) Command

This command is used to read part of a menu or amplifier setting conditions.

① Format



② Parameter

n=1: Outputs the menu setting conditions.

n=2: Outputs amplifier conditions 1.

n=3: Outputs amplifier conditions 2.

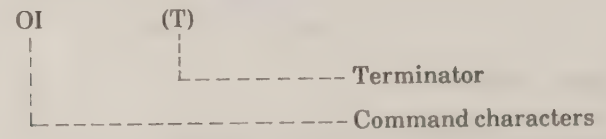
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.8 OI (Output Identify) Command

This command is used to cause the WR3600 to output "WR-3600 CR/LF."

① Format



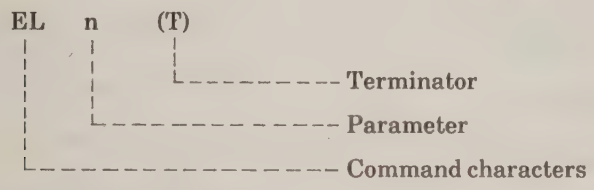
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.9 EL (Event Marker Left) Command

This command is used to set the left-side event marker on and off.

① Format



② Parameter

n=0: Sets the left-side event marker recording line to off.

n=1: Sets the left-side event marker recording line to on.

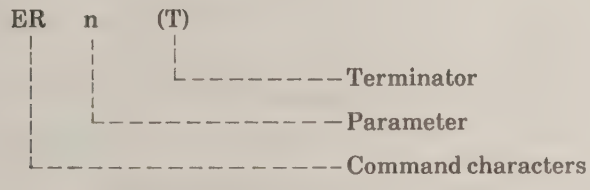
③ Terminator: CR/LF

④ Valid conditions: Valid in either the STOP or the START condition.

3.4.10 ER (Event Marker Right) Command

This command is used to set the right-side event marker on and off.

① Format



② Parameter

n=0: Sets the right-side event marker recording line to off.

n=1: Sets the right-side event marker recording line to on.

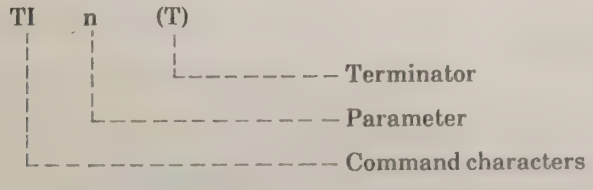
③ Terminator: CR/LF

④ Valid conditions: Valid in either the STOP or the START condition.

3.4.11 TI (Time Interval Setting) Command

This command is used to set the timer marker output interval.

① Format



② Parameter

n=0: Timer off

n=1: 0.1-s interval

n=2: 1-s interval

n=3: 10-s interval

n=4: Timer off

n=5: 0.1-min interval

n=6: 1-min interval

n=7: 10-min interval

③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.12 TD (Time-Code/Internal) Command

This command is used to select either the time code or the internal clock for the master printing of date and time.

① Format

TD n (T)

- (T) — Terminator
- n — Parameter
- TD — Command characters

② Parameter

n=0: Selects the internal clock

n=1: Selects the IRIG time code.

③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.13 DS (Date Setting) Command

This command is used to set the date for the internal clock of the WR3600.

① Format

DS mm dd yy (T)

- (T) — Terminator
- mm dd yy — Parameters
- DS — Command characters

② Parameters

mm: month (01 to 12)

dd: day (01 to 31)

yy: year (00 to 99)

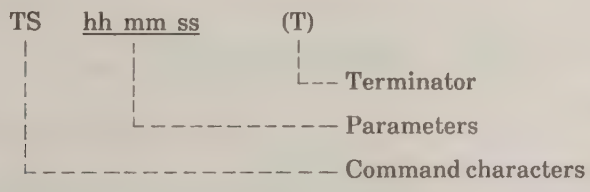
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.14 TS (Time Setting) Command

This command is used to set the time for the internal clock of the WR3600.

① Format



② Parameters

hh: hour (00 to 23)

mm: minute (00 to 59)

ss: second (00 to 59)

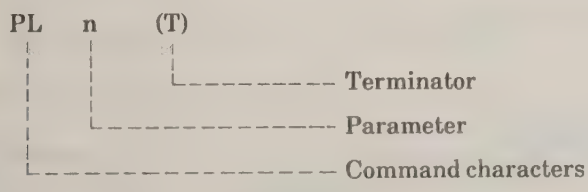
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.15 PL (Print Repeat Length) Command

This command is used to set the interval for master print repetition.

① Format



② Parameter

n = 0: No printing

n = 1: Print on every page.

n = 2: 100-mm interval

n = 3: 200-mm interval

n=4: 300-mm interval

n=5: 400-mm interval

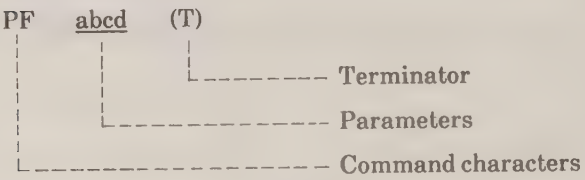
n=6: 500-mm interval

③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.16 PF (Print Format) Command

① Format



② Parameters

a=0: Do not print date in master print.

a=1: Print date in master print.

b=0: Do not print time in master print.

b=1: Print time in master print.

c=0: Do not print speed in master print.

c=1: Print speed in master print.

d=0: Do not print time scale in master print.

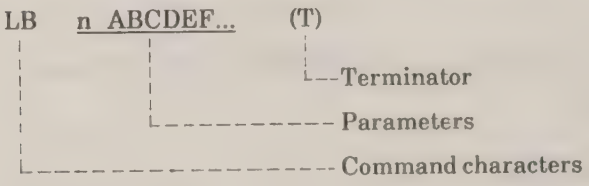
d=1: Print time scale in master print.

③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.17 LB (Label Print) Command

① Format



② Parameters

n: Channel number for printing (1 to 8)

ABCDEF: ASCII string of up to 128 characters

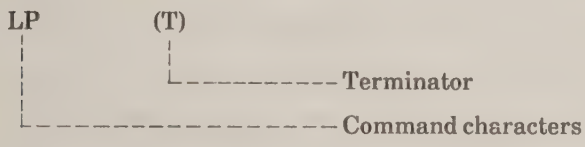
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.18 LP (Label Print) Command

This command is used to enable output of the character string set up using the LB command at the interval set up using the PL command. If this is done, text printing is not possible.

① Format



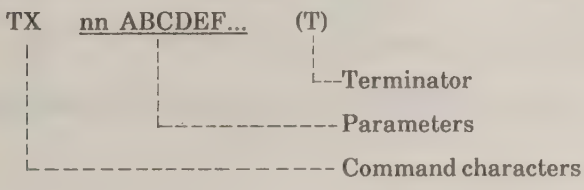
② Terminator: CR/LF

③ Valid conditions: Valid in the STOP condition.

3.4.19 TX (Text Print) Command

This command is used to input text of 80 columns by 40 lines, text being input by line and output by the XP command.

① Format



② Parameters

nn: No. of lines to be printed (01 to 40)

ABCDEF: ASCII character string of up to 80 characters

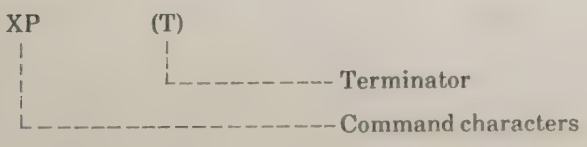
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.20 XP (Text Print Start) Command

This command is used to enable output onto the chart paper of the character string specified using the TX command at the interval specified by the PL command.

① Format



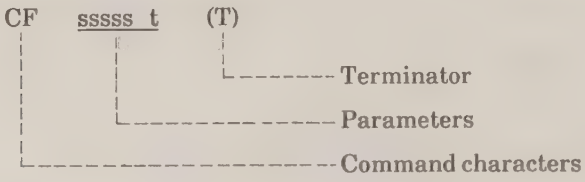
② Terminator: CR/LF

③ Valid conditions: Valid in the STOP condition.

3.4.21 CF (Chart Feed Speed Setting) Command

This command is used to set the chart feed speed.

① Format



② Parameters

sssss: 0.001 to 200.0, and 500.0 mm

t="S": /s

t="M": /min

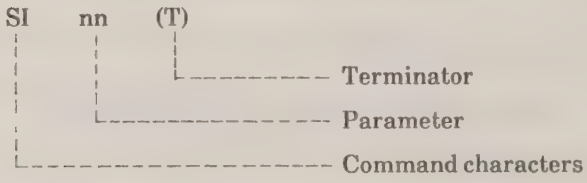
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.22 SI (Sampling Interval Time Setting) Command

This command is used to set the interval time for sampling analog signals in the memory mode.

① Format



② Parameter

nn=00: 10 μs

nn=01: 20 μs

nn=02: 50 μs

nn=03: 100 μs

nn=04: 200 μs

nn=05: 500 μs

nn=06: 1 ms

nn=07: 2 ms

nn=08: 5 ms

nn=09: 10 ms

nn=10: 20 ms

nn=11: 50 ms

nn=12: 100 ms

nn=13: 200 ms

nn=14: 500 ms

nn=15: External

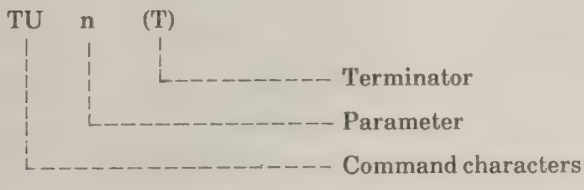
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.23 TU (Trigger Source) Command

This command is used to set the source for the trigger used in the memory mode and in the run-time and run-length settings.

① Format



② Parameter

n=0: Manual triggering

n=1: Internal triggering

n=2: External triggering

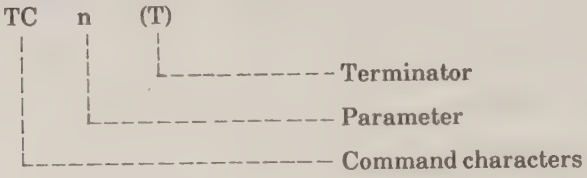
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.24 TC (Trigger Channel Setting) Command

This command is used to set the channel from which the trigger is to be taken for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n: Selected trigger channel

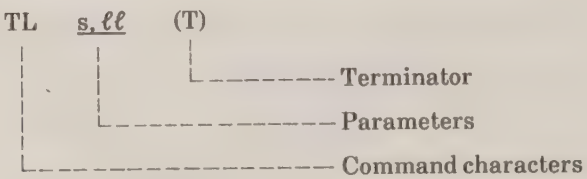
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.25 TL (Trigger Level Setting) Command

This command is used to set the trigger level for the memory mode and the run-time and run-length settings.

① Format



② Parameters

s: Polarity

ℓℓ: Level (00 to 50)

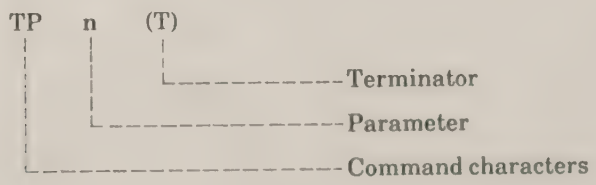
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.26 TP (Trigger Slope Setting) Command

This command is used to set the trigger slope for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n=0: Rising edge

n=1: Falling edge

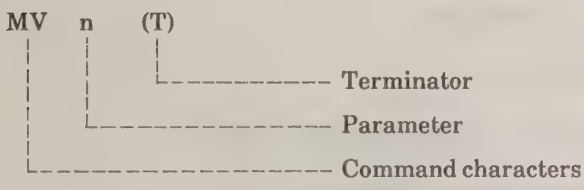
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.27 MV (Memory Volume) Command

This command is used to set the memory volume (capacity) for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n=0: 0.25 Kword

n=1: 0.5 Kword

n=2: 1 Kword

n=3: 2 Kwords

n=4: 4 Kwords

n=5: 8 Kwords

n=6: 16 Kwords

n=7: 32 Kwords

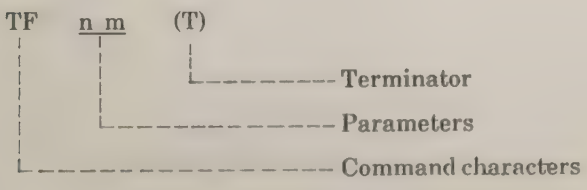
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.28 TF (Trigger Function Setting) Command

This command is used to set the trigger function (pre-, post- or normal triggering) for the memory mode and run-time and run-length settings and to set the offset value.

① Format



② Parameters

n=0: Normal triggering

n=1: Pre-triggering

n=2: Post-triggering

m=0: 0% offset

m=1: 12.5% offset

m=2: 25% offset

m=3: 50% offset

m=4: 100% offset

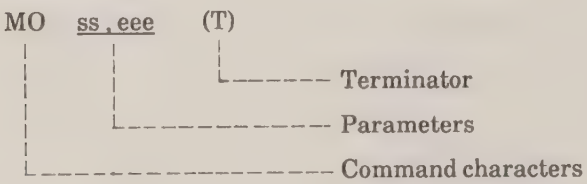
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.29 MO (Memory Output Area) Command

This command is used to set the memory recording output range for the memory mode and the run-time and run-length settings.

① Format



② Parameters

ss=0: Memory output starting % (00 to 99)

eee=0: Memory output ending % (001 to 100)

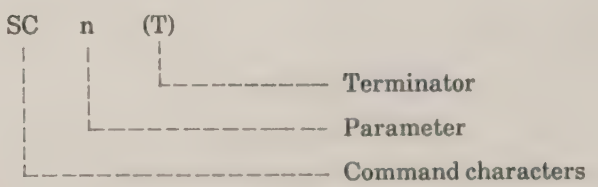
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.30 SC (Scaling Factor) Command

This command is used to set the memory recording output time-axis scaling for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n=0: 1/1 n=1: 1/2

n=2: 1/4 n=3: 1/8

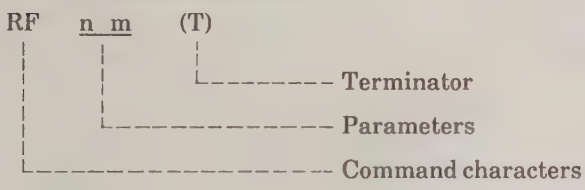
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.31 RF (Recording Format) Command

This command is used to select Y-T and X-Y waveform recording and to enable or disable the menu list.

① Format



② Parameters

n=0: Y-T format selected

n=1: X-Y format selected

m=0: No menu list printout

m=1: Menu list printout

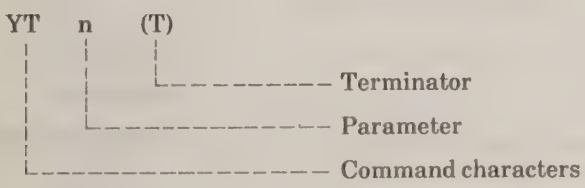
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.32 YT (Y-T Format) Command

This command is used to select the Y-T recording width as single, double, or wide.

① Format



② Parameter

n=0: Single

n=1: Double

n=2: Wide

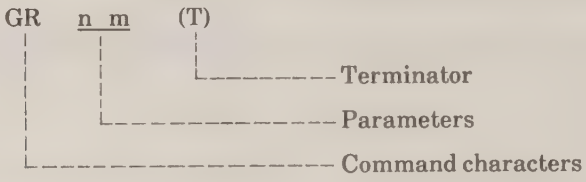
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.33 GR (Grid Type) Command

This command is used to set the type of grid and existence or non-existence of fine grid marks for the Y-T recording mode.

① Format



② Parameters

n=0: Grid off

n=1: 10 × 10 mm

n=2: 5 × 5 mm

n=3: 5 × 4 mm

m=0: No fine grid

m=1: Fine grid

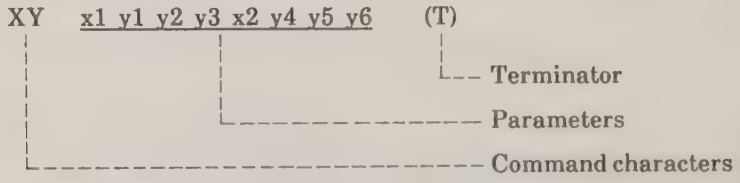
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.34 XY (X-Y Format) Command

This command is used to set the correspondence of channels to various axes for X-Y mode recording.

① Format



② Parameters

x1: Upper X-axis channel number (1 to 4)

y1: Upper y1-axis channel number (1 to 4)

y2: Upper y2-axis channel number (1 to 4)

y3: Upper y3-axis channel number (1 to 4)

x2: Lower X-axis channel number (5 to 8)

y4: Lower y1-axis channel number (5 to 8)

y5: Lower y2-axis channel number (5 to 8)

y6: Lower y3-axis channel number (5 to 8)

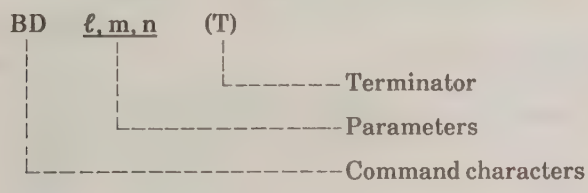
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.35 BD (Output Binary Data) Command

This command is used to read out data stored in memory in binary format.

① Format



② Parameters

ℓ: Channel number (1 to 8)

m: Data starting point (0 to 32767)

n: Number of data (1 to 32768)

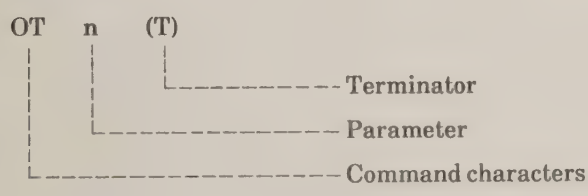
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.36 OT (Output Interval Setting) Command

This command is used to set the recording interval for the direct logging mode.

① Format



② Parameter

n=0:	1 s	n=1:	10 s
n=2:	1 min	n=3:	10 min

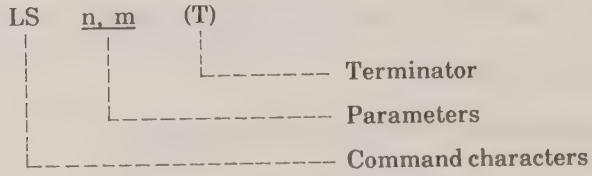
③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.4.37 LS (Logging Scale Factor Setting) Command

This command is used to set the recording interval for the direct logging mode.

① Format



② Parameters

n: Low-side full scale (−99999 to +99998)

m: High-side full scale (−99998 to +99999)

③ Terminator: CR/LF

④ Valid conditions: Valid in the STOP condition.

3.5 Validity of Commands in Various Operating Modes

WR3600 Interface Command (1/2)			Direct YT		Direct XY		Direct Logging		Memory Save		Memory Output	
Item	Com-mand	Function	Start	Stop	Start	Stop	Start	Stop	Start	Stop	Start	Stop
Initialization	IN	INITIALIZE	○	○	○	○	○	○	○	○	○	○
	MD	MODE SET	×	○	×	○	×	○	×	○	×	○
	TG0	RECORD START	×	○	×	○	×	○	○	○	×	○
	TG1	RECORD STOP	○	×	○	×	○	×	○	×	○	×
	FF	FORM FEED	×	○	×	○	×	○	×	○	×	○
	LI	LIST OUT	×	○	×	○	×	○	×	○	×	○
Status output	OS	OUTPUT STATUS	○	○	○	○	○	○	○	○	○	○
	OR1	OUTPUT REPORT 1	×	○	×	○	×	○	×	○	×	○
	OR2	OUTPUT REPORT 2	×	○	×	○	×	○	×	○	×	○
	OR3	OUTPUT REPORT 3	×	○	×	○	×	○	×	○	×	○
	OI	OUTPUT IDENTITY	×	○	×	○	×	○	×	○	×	○
Event	EL	EVENT LEFT ON/OFF	○	○	×	×	×	×	×	×	×	×
	ER	EVENT RIGHT ON/OFF	○	○	×	×	×	×	×	×	×	×
Timer	TI	TIME INTERVAL SET	×	○	×	×	×	×	×	×	×	×
Clock	TD	TIME CODE/ INTERNAL	×	○	×	×	×	×	×	×	×	×
	DS	DATE SET	×	○	×	○	×	○	×	○	×	○
	TS	TIME SET	×	○	×	○	×	○	×	○	×	○
Printing format	PL	PRINT REPEAT LENGTH	×	○	×	×	×	×	×	×	×	×
	PF	PRINT FORMAT	×	○	×	×	×	×	×	×	×	×
	LB	PRINT LABEL	×	○	×	×	×	×	×	×	×	×
	LP	LABEL PRINT START	×	○	×	×	×	×	×	×	×	×

WR3600 Interface Command (2/2)			Direct YT		Direct XY		Direct Logging		Memory Save		Memory Output	
Item	Com-mand	Function	Start	Stop	Start	Stop	Start	Stop	Start	Stop	Start	Stop
Printing format	TX	PRINT TEXT	×	○	×	×	×	×	×	×	×	×
	XP	TEXT PRINT START	×	○	×	×	×	×	×	×	×	×
Chart control	CF	CHART SPEED VI	×	○	×	×	×	×	×	×	×	×
Memory mode	SI	SAMPLING INTERVAL TIME	×	×	×	×	×	×	×	○	×	×
	TU	TRIGGER SOURCE	×	×	×	×	×	×	×	○	×	×
	TC	TRIGGER CHANNEL	×	×	×	×	×	×	×	○	×	×
	TL	TRIGGER LEVEL	×	×	×	×	×	×	×	○	×	×
	TP	TRIGGER SLOPE	×	×	×	×	×	×	×	○	×	×
	MV	MEMORY VOLUME	×	×	×	×	×	×	×	○	×	×
	TF	TRIGGER FUNCTION	×	×	×	×	×	×	×	○	×	×
	MO	MEMORY OUTPUT	×	×	×	×	×	×	×	×	×	○
	SC	SCALING FACTOR	×	×	×	×	×	×	×	○	×	○
Recording format	RF	RECORD FORMAT	×	○	×	○	×	×	×	○	×	○
	YT	Y-T FORMAT	×	○	×	×	×	×	×	○	×	○
	GR	GRID TYPE	×	○	×	×	×	×	×	○	×	○
	XY	X-Y FORMAT	×	×	×	○	×	×	×	○	×	○
Data output	BD	BINARY DATA OUT	×	×	×	×	×	×	×	○	×	○
Logging mode	OT	OUTPUT INTERVAL	×	×	×	×	×	○	×	×	×	×
	LS	LOGGING SCALE FACTOR	×	×	×	×	×	○	×	×	×	×

3.6 Typical Command Usage Examples (RS-232C)

The WR3600 is provided with a set of interface commands used for data transfer and summarized in the interface command table. This section will provide examples of using the RS-232C interface which is provided as standard with a PC-9801 personal computer used to control the recorder, giving typical examples of command usage.

3.6.1 Main Menu Status Transfer Command (OR1)

This command is used to output the main menu setting conditions to the computer.

(a) Program Example

```
10
20    WR3600 SAMPLE PROGRAM for RS-232C
30
40
50    OPEN "COM1 : 9600, N, 8, 1, RS, CS, DS" AS #1
60    PRINT #1, "OR1"
70    LINE INPUT #1, A$
80    PRINT A$
90    END
```

Fig. 3-8 OR1 Command Program Example

The above program is described below.

50 Open file 1 for RS-232C transfer

60 Send the OR1 command

70 Set A$ to the received data.

80 Display the contents of A$ on the computer screen.

(b) Operations Required for Transfer

The operations required for transfer are as follows.

① Load the program shown in Fig. 3-8 into the computer.

② Verify that the RS-232C interface DIP switch settings have been made properly.

③ Press the CONTROL key on the WR3600 to enable the REMOTE (I/F) mode.

④ Run the program on an IBM PC/AT/XT.

The above operations execute the program shown in Fig. 3-8, causing data to be displayed on the CRT screen.

(c) Transferred Data Contents

The transferred data format is shown in Fig. 3-9.

Digit Sequence	Character	Description
1	M	Memory mode
2 3 4	0 0 8	Memory size 8 Kwords
5 6 7	1 M 2	Sampling interval Sampling units ms Second power of 10 — 100 ms
8	1	Trigger channel 1
9	L	Internal trigger
10	R	Trigger slope
11 12 13	+ 2 5	Trigger point 75%
14	P	Pre-trigger
15	4	Trigger offset 25%
16	SP	

Fig. 3-9 Transferred Data Contents (OR1)

3.6.1 Amplifier Setting Condition Transfer (OR2, OR3 Commands)

These commands are used to read out the amplifier settings.

(a) Program Example

```
10
20  ' WR3600 SAMPLE PROGRAM for RS-232C
30
40
50  OPEN "COM1 : 9600, N, 8, 1, RS, CS, DS" AS #1
60  PRINT #1, "OR2"
70  FOR I = 1 TO 8
80  LINE INPUT #1, A$
90  PRINT A$
95  NEXT I
100 END
```

Fig. 3-10 OR2 Command Program Example

The major lines of the program in Fig. 3-10 are described below.

50 Open file 1 for RS-232C transfer

60 Send the OR2 command

80 Set A$ to the received data.

80 Display the contents of A$ on the computer screen.

(b) Operations Required for Transfer

The operations required for transfer are as follows.

① Load the program shown in Fig. 3-10 into the computer.

② Verify that the RS-232C interface DIP switch settings have been made properly.

③ Press the CONTROL key on the WR3600 to enable the REMOTE (I/F) mode.

④ Run the program on on an IBM PC/AT/XT.

The above operations execute the program shown in Fig. 3-10, causing data to be displayed on the CRT screen.

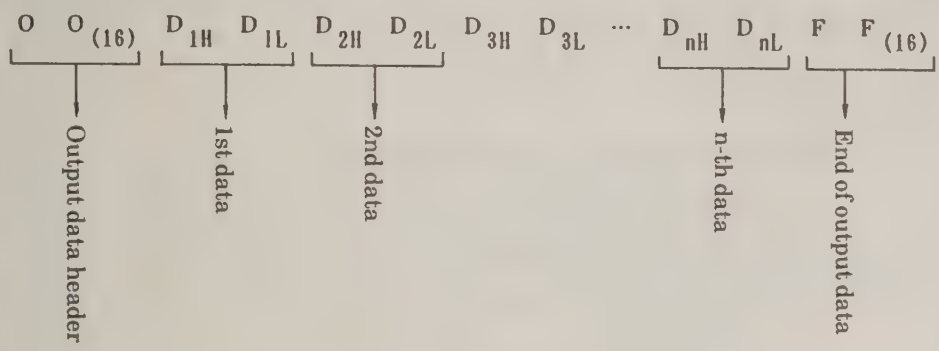
(c) Transferred Data Contents

The transferred data format is shown in Fig. 3-11.

Digit Sequence	Character	Description
1	1	Channel No.
2	S	MEAS/GND/OFF Switch set to MEAS
3	SP	Space
4 5 6 7	0 5 0 0	Range knob (Range display converted to mV units)
8	E	
9	0	× 1 mV
10	SP	Space

Fig. 3-11 Transferred Data Contents (OR2)

Format 1 (Binary Data)

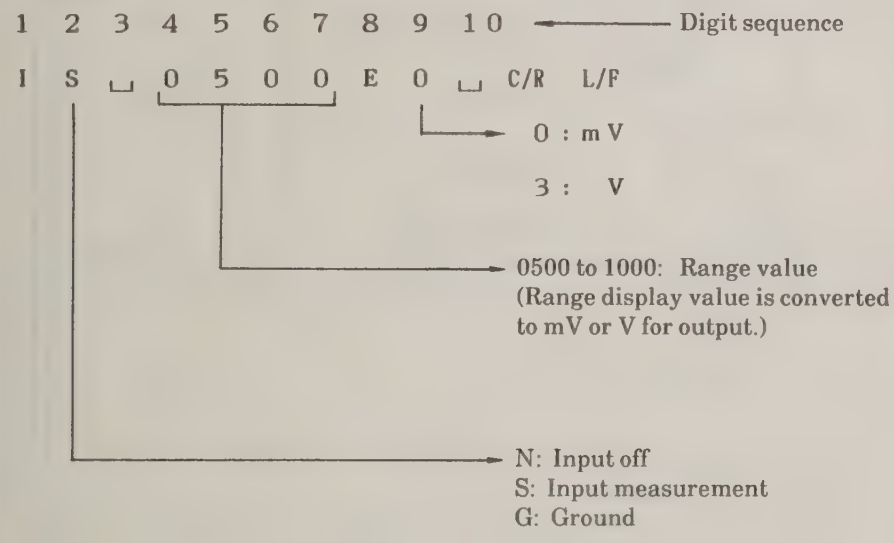


- D_{nH} is upper byte of data (00 to $0F_{16}$)

  D_{nL} is lower byte of data (00 to $0F_{16}$)

- $D_{nH}D_{nL}$ value example: For the ×10-V range FFF: +10 V
  000: −10 V

Format 2 (Amplifier Setting Conditions-1)


1 2 3 4 5 6 7 8 9 10
Digit sequence
I S ␣ 0 5 0 0 E 0 ␣ C/R L/F
0 : mV
3 : V
0500 to 1000: Range value
(Range display value is converted
to mV or V for output.)
N: Input off
S: Input measurement
G: Ground

Format 3 (Amplifier Setting Conditions-2)

1 2 3 4 5 6 7 8

1 + 2 5 ␣ ␣ ␣ ␣ C/R L/F

– 50% to + 50%: Amp position

1 to 8: Channel no.

Format 4 (Status Signal)

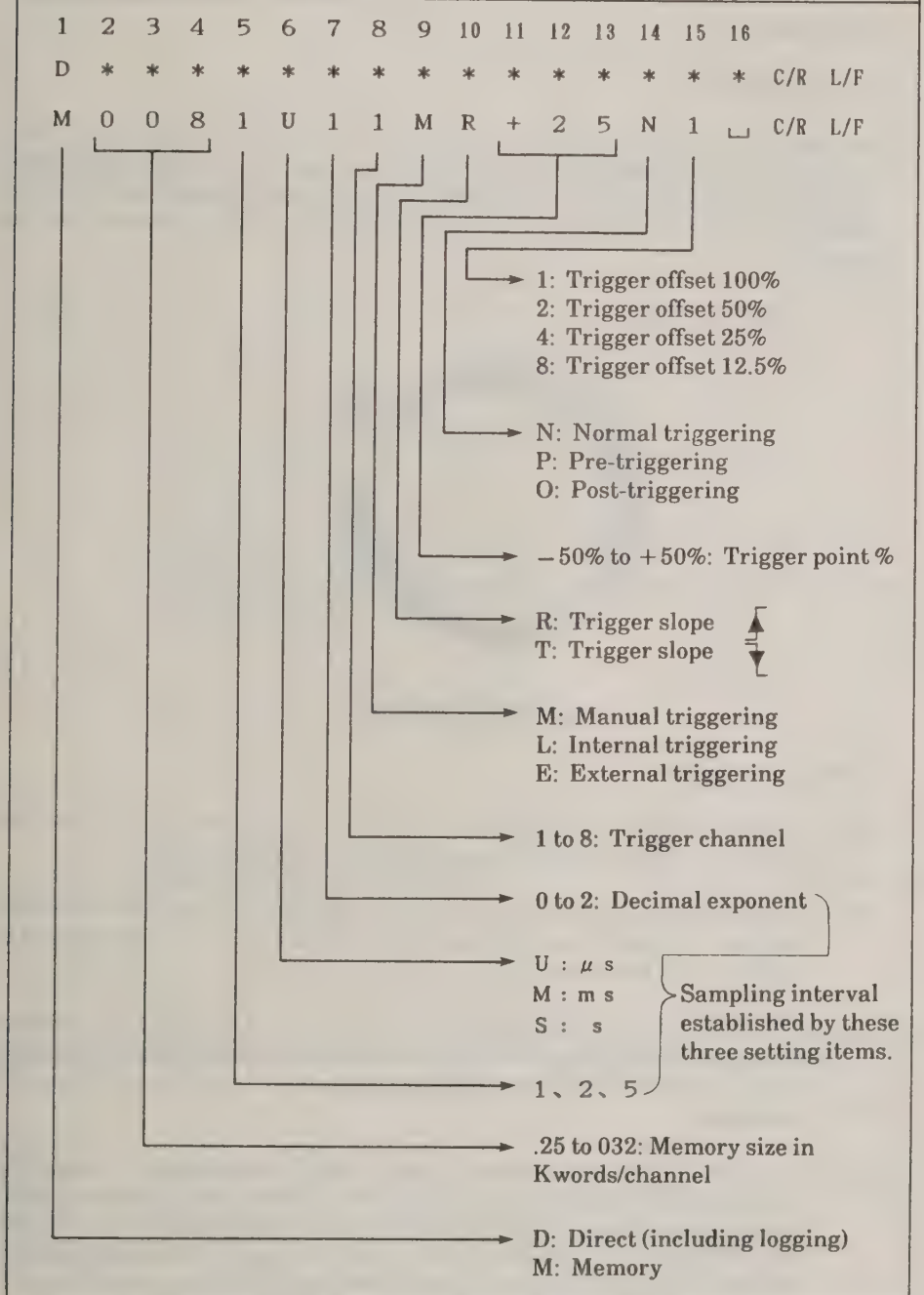
1 2 3 4 5 6

␣ ␣ ␣ ␣ 3 2 C/R L/F

0 to 255: Decimal representation of status byte value

On	Value	Contents	Name
1	1		
2	2		
3	4		
4	8		
5	16	Bit set on during measurement or recording	
6	32	Bit set on if any of the following occurs. • Interface error • Command error • Character FF received	ERROR
7	64	On for paper end condition	PAPER END
8	128		

Format 5 (Major Menu Setting Conditions)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
D * * * * * * * * * * * * * * * C/R L/F
M 0 0 8 1 U 1 1 M R + 2 5 N 1 ␣ C/R L/F
1: Trigger offset 100%
2: Trigger offset 50%
4: Trigger offset 25%
8: Trigger offset 12.5%
N: Normal triggering
P: Pre-triggering
O: Post-triggering
−50% to +50%: Trigger point %
R: Trigger slope
T: Trigger slope
M: Manual triggering
L: Internal triggering
E: External triggering
1 to 8: Trigger channel
0 to 2: Decimal exponent
U : μ s
M : m s
S : s
1、2、5
Sampling interval established by these three setting items.
.25 to 032: Memory size in Kwords/channel
D: Direct (including logging)
M: Memory

With the WR3600 Thermal Arraycorder in the hold condition, it is possible to transfer data stored in memory to an external device using the GPIB interface. This section describes the method of effecting this.

3.7 GPIB Interface

3.7.1 Interface Cable

The method of connection when the GPIB interface is provided is to use a commercially available GPIB cable (24-pin connectors at each end) which conforms to IEEE standards, this cable making the connection between the rear-panel GPIB connector of the Arraycorder and the GPIB connector of the computer.

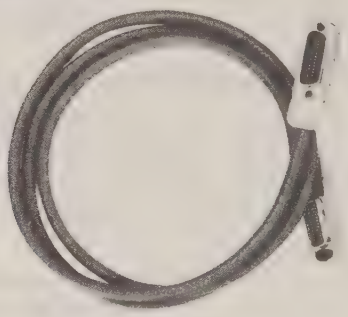


Fig. 3-12 GPIB Cable

3.7.2 GPIB Description

(a) GPIB logic uses a low (0.8 V max.) level for true and a high (2.0 V min.) for false. The connector pin arrangement is shown in Fig. 3-13.

(b) The handling of addresses depends upon the type of computer connected, and can be done by using the specified address of devices connected or by using a multi-line message.

For direct address specification, if PRINT@1: "OR1" is used, and the address of the equipment is 1, the OR1 command is sent from the computer to the recorder. This is used when the computer is a talker and is sending commands.

The multi-line message method is used in the listener mode by adding 20_{16} to the specified address and by adding 40_{16} to the specified address in the talker mode. For data transfer, after certain commands (RBYTE, WBYTE, etc.) GET, &H05 (UNL), and &H03 (UNT) unique GPIB messages are sent from the computer. Depending upon the type of computer used, it may be necessary to specify equipment connected as certain addresses.

b_7 / b_6 / b_5				0 0 0	MSG	0 0 1	MSG	0 1 0	MSG	0 1 1	MSG	1 0 0	MSG	1 0 1	MSG	1 1 0	MSG	1 1 1	MSG
b_4	b_3	b_2	b_1	COLUMN / ROW		0		1		2		3		4 4		5		6		7	
0	0	0	0	0	NUL		DLE		SP		0		@		P		`		p	
0	0	0	1	1	SOH	GTL	DC1	LLO	!		1		A		Q		a		q	
0	0	1	0	2	STX		DC2		"		2		B		R		b		r	
0	0	1	1	3	ETX		DC3		#		3		C		S		c		s	
0	1	0	0	4	EOT	SDC	DC4	DCL	$		4		D		T		d		t	
0	1	0	1	5	ENQ	PPC	NAK	PPU	%		5		E		U		e		u	
0	1	1	0	6	ACK		SYN		&		6		F		V		f		v	
0	1	1	1	7	BEL		ETB		'		7		G		W		g		w	
1	0	0	0	8	BS	GET	CAN	SPE	(		8		H		X		h		x	
1	0	0	1	9	HT	TCT	EM	SPD	)		9		I		Y		i		y	
1	0	1	0	10	LF		SUB		*		:		J		Z		j		z	
1	0	1	1	11	VT		ESC		+		;		K		[		k		{	
1	1	0	0	12	FF		FS		,		<		L		\		l		:	
1	1	0	1	13	CR		GS		-		=		M		]		m		}	
1	1	1	0	14	SO		RS				>		N		^		n		~	
1	1	1	1	15	SI		US		/		?	UNL	O		_	UNT	o		DEL	

MLA listener address

MLA listener address

MTA talker address

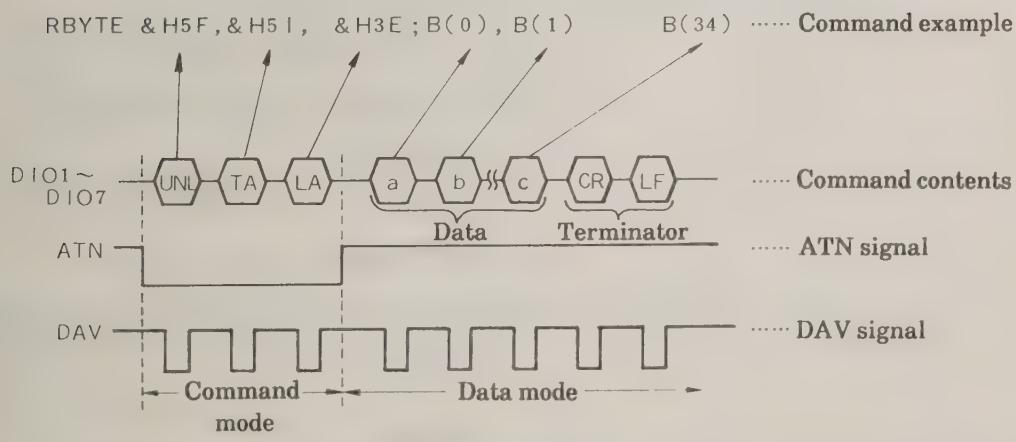
MTA talker address

Determined by next command

Determined by next command

Address | Universal | Listen | Talk | Secondary commands

Primary commands



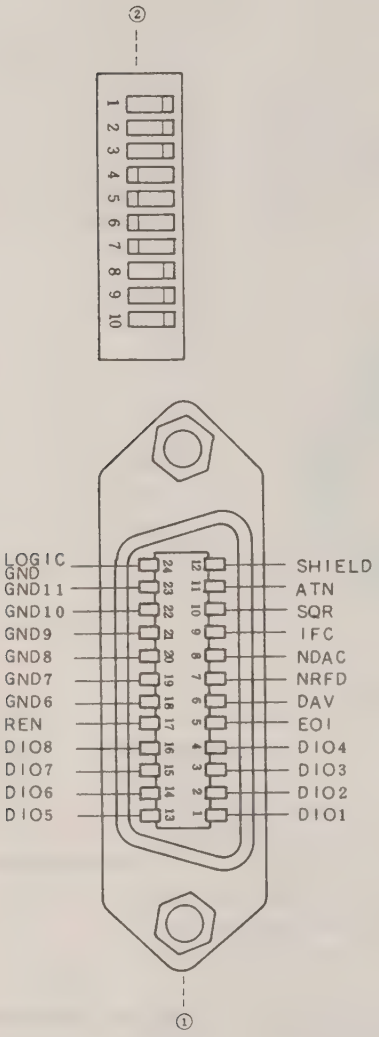
Data send/receive sequence

Multiline Message Example

(From NEC PC9801-29 instruction manual)

3.7.3 GPIB Interface Connector Table and Function Setting Switches

Equipment which is specified for use with the GPIB interface for data transfer will have a GPIB interface subpanel on its rear panel, as shown at the left.



The various parts of the panel are as follows.

① GPIB connector: This is a 24-pin GPIB interface connector conforming to IEEE-488 standards. The signal connections are shown at the left.

② SI switch: These DIP switches are used to set GPIB device addresses and functions.

Note GPIB Device Address

The SI DIP switches are set as follows. Note that 0 is ON and that 1 is the opposite position.

No.	Description	
8	LSB	Device Address
7		
6		
5		
4	MSB	
3	1: EOI Enabled	0: EOI Disabled
2	1: Talk only	0: Addressable
1	Always set to 1	

① Device Address

Note that the address setting of 31 in which positions 4 through 8 are all set to 1 is not possible.

② Talk Only

If the second position of the DIP switch is set to 1, the talk-only mode is enabled and the address setting of positions 4 to 8 is ignored.

③ To enable EOI, set position 3 to 1.

3.8 Data Transfer

3.8.1 Data Transfer Types

To an external computer using a built-in GPIB interface.

- Main front panel or menu setting conditions
- Amplifier setting conditions
- Memory data captured in the memory mode
- Date, time and data in the logging mode

3.8.2 Basic Transfer Protocols

(a) Signal Cable Connections

For the GPIB, a commercially available IEEE-488 (24 conductor) cable is used to make connections between the WR3600 and the computer.

(b) Interface Switch Settings

For the GPIB, the switches are used to set the address and the mode.

(c) Loading the Transfer Program

A transfer program for the particular computer to be used is generated and loaded.

(d) WR3600 Measurement Condition Settings

The WR3600 is placed in the measurement condition, and a data capture is tried to enable operating panel and menu settings to be made. Then CONTROL switch is pressed to place the recorder in the REMOTE (interface) mode.

(e) WR3600 Measurement Start and Stop

In general, the measurement is started and then the STOP key is pressed to stop the measurement after verifying that data has been captured.

(f) Running the Computer Program

The computer program is run to start the WR3600 measurement and data transfer sequence.

3.8.3 Commands

The control and transfer commands used in generating the program for the WR3600 are shown in the interface command table.

3.8.4 Transfer Data Format

Main front panel and menu setting conditions, amplifier setting conditions and in the logging mode, printed date and time and data, all transferred as ASCII character codes.

Memory data captured in the memory mode is transferred as binary-coded data.

3.9 WR3600 Interface Command Table (1)

Command	Format	Contents of n and m, and applications	Output Data Format	Remarks
INITIAL	IN (T)	WR3600 Initialization		
MODE SET	MDn (T)	n = 1 : Direct 2 : Logging 3 : Memory save 4 : Memory output		
RECORD START	TG0 (T)	WR3600 Start recording		
RECORD STOP	TG1 (T)	WR3600 Stop recording		
FORM FEED	FF (T)	Chart paper feed form feed (page feed)		
LIST OUT	LI (T)	List output		
OUTPUT STATUS	OS (T)	Read Status Data	Format 4	
OUTPUT REPORT	ORn (T)	n = 1: Read operating panel setting conditions n = 2: Read 1 of amplifier setting conditions n = 3: Read 2 of amplifier setting conditions	Format 5 Format 2 Format 3	Valid when recorder is stopped
OUTPUT IDENTITY	OI (T)	Read model name data		Valid when recorder is stopped

WR3600 Interface Command Table (2)

Command	Format	Contents of n and m, and applications	Output Data Format	Remarks
EVENT LEFT ON/OFF	ELn (T)	n = 0: Set left event marker to off n = 1: Set left event marker to on		
EVENT RIGHT ON/OFF	ERn (T)	n = 0 : Set right event marker to off n = 1 : Set right event marker to on		
ERROR CLEAR	EC (T)	Clears the error flag read by the OS command		
INTERRUPT MASK	IMn (T)	n = 0: Interrupt mask set n = 1: Interrupt mask cleared		
TIMER INTERVAL SET	TIn (T)	n = 0: off n = 1: 0.1 s n = 2: 1 s n = 3: 10 s n = 4: off n = 5: 0.1 min n = 6: 1 min n = 7: 10 min		
TIME-CODE/INTERNAL	TDn (T)	n = 0: Internal clock n = 1: IRIG Time code		Requires time code option
DATE SET	DSmmddyy (T)	mmddyy: mm = month dd = day yy = year		
TIME SET	TShhmmss (T)	hhmmss: hh = hour mm = minute ss = second		
PRINT REPEAT LENGTH	PLn (T)	n = 0: no repeat n = 1: each page n = 2: 100 mm n = 3: 200 mm n = 4: 300 mm n = 5: 400 mm n = 6: 500 mm		

WR3600 Interface Command Table (3)

Command	Format	Contents of n and m, and applications	Output Data Format	
PRINT FORMAT	PFabcd (T)	a = 0: No DATE printing b = 0: No TIME printing c = 0: No SPEED printing d = 0: No TIME SCALE printing a = 1: Print DATE b = 1: Print TIME c = 1: Print SPEED d = 1: Print TIME SCALE		
PRINT LABEL	LBnABC · · · (T)	n: Channel No. for printing (1-8) ABC · · ·: ASCII character string of up to 128 characters		
LABEL PRINT START	LP (T)	Start label printing		
PRINT TEXT	TXnnABC · · · (T)	nn: Line number for printing (01-40, must be 2 digits) ABC: ASCII character string of up to 40 characters		
TEXT PRINT START	XP (T)	Start text printing		
CHART SPEED SET	CFssssst (T)	ssssss: 0.001 to 200.0 mm or 500.0 mm t = S : /s t = M : /min		
SAMPLING INTERVAL TIME	SInn (T)	nn = 00: 10 µs nn = 01: 20 µs nn = 02: 50 µs nn = 03: 100 µs nn = 04: 200 µs nn = 05: 500 µs nn = 06: 1 ms nn = 07: 2 ms nn = 08: 5 ms nn = 09: 10 ms nn = 10: 20 ms nn = 11: 50 ms nn = 12: 100 ms nn = 13: 200 ms nn = 14: 500 ms nn = 15: EXTERNAL		Requires memory unit option

WR3600 Interface Command Table (4)

Command	Format	Contents of n and m, and applications	Output Data Format	Remarks
TRIGGER SOURCE	TUn (T)	n = 0: MANUAL n = 1: INTERNAL n = 2: EXTERNAL		Requires memory unit option
TRIGGER CHANNEL	TCn (T)	n: Valid trigger channel (1-8)		Requires memory unit option
TRIGGER LEVEL	TLs $\ell\ell$ (T)	S: Polarity (+ or −) $\ell\ell$: Level (00 to 50)		Requires memory unit option
TRIGGER SLOPE	TPn (T)	n = 0: n = 1:		
MEMORY VOLUME	MVn (T)	n = 0: 0.25 Kword n = 1: 0.5 Kword n = 2: 1 Kword n = 3: 2 Kwords n = 4: 4 Kwords n = 5: 8 Kwords n = 6: 16 Kwords n = 7: 32 Kwords		Requires memory unit option
TRIGGER FUNCTION	TFnm (T)	n = 0: Normal triggering n = 1: Pre-triggering n = 2: Post-triggering m = 0: 0% m = 1: 12.5% m = 2: 25% m = 3: 50% m = 4: 100%		Requires memory unit option

WR3600 Interface Command Table (5)

Command	Format	Contents of n and m, and applications	Output Data Format	
MEMORY OUTPUT AREA	MOsseee (T)	ss: Memory output starting % (00 to 99) eee: Memory output ending % (001 to 100)		Requires memory unit option
SCALING FACTOR	SCn (T)	n = 0: 1/1 n = 1: 1/2 n = 2: 1/4 n = 3: 1/8		Requires memory unit option
RECORD FORMAT	RFnm (T)	n = 0: Y-T format n = 1: X-Y format m = 0: No list printoutm = 1: List printout		
Y-T FORMAT	YTn (T)	n = 0: Single n = 1: Double n = 2: Wide		
GRID TYPE	GRnm (T)	n = 0: off n = 1: 10 mm × 10 mm n = 2: 5 mm ×5 mm n = 3: 5 mm × 4 mm m = 0: No fine grid m = 1: Fine grid		
X-Y FORMAT	XYx1y1y2y3x2y4y 5y6 (T)	x1: X-axis channel (1 to 4) y1: Y1-axis channel (0 to 4) *0 is off y2: Y2-axis channel (0 to 4) " y3: Y3-axis channel (0 to 4) " x2: X-axis channel (5 to 8) y4: Y1-axis channel (0, 5 to 8) *0 is off y5: Y2-axis channel (0, 5 to 8) " y6: Y3-axis channel (0, 5 to 8) "		

WR3600 (Interface Command Table)

Command	Format	Contents of n and m, and applications	Output Data Format	
BINARY DATA	BD ℓ, m, n (T)	ℓ: Readout channel specification (1 to 8) m: Data starting point (0 to 32767) n: Number of data (1 to 32768)	Format 1	Requires memory unit option Valid when recorder is stopped
OUTPUT INTERVAL	OT n (T)	n = 0: 1 s n = 1: 10 s n = 2: 1 min n = 4: 10 min		
LOGGING SCALE FACTOR	LSn, m (T)	n: Low-side full scale (−99999 to +99998) m: High-side full scale (−99998 to +99999)		

3.10 Detailed Command Descriptions

When performing data transfer with the WR3600, 40 commands are used. These are described below in detail.

3.10.1 IN (Initialize) Command

This command places the WR3600 in the same condition as when power is first applied.

① Format

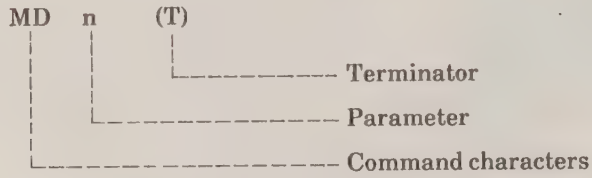
② Terminator: CR/LF

③ Valid conditions: Valid in either the START or the STOP condition.

3.10.2 MD (Mode Set) Command

This command is used to set the WR3600 operating mode.

① Format



② Parameter

n=1: Sets the WR3600 to the direct mode.

n=2: Sets the WR3600 to the logging mode.

n=3: Sets the WR3600 to the memory save mode.

n=4: Sets the WR3600 to the memory out mode.

③ Terminator: CR/LF

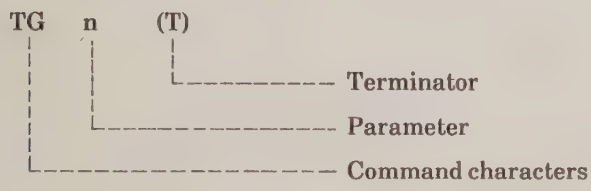
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.3 TG (Trigger) Command

This command is used in place of the START and STOP keys.

① Format



② Parameter

n=0: Sets the WR3600 to the START condition.

n=1: Sets the WR3600 to the STOP condition.

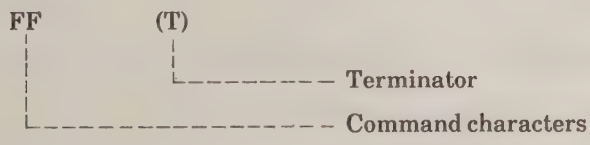
③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode

3.10.4 FF (Form Feed) Command

This command is used to feed Z-fold paper to the next sensing mark and to feed roll paper approximately 300 mm.

① Format



② Terminator: CR/LF

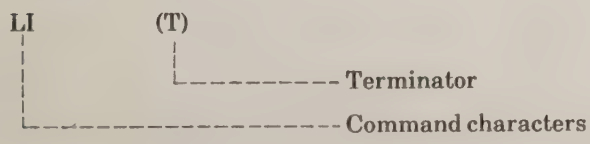
③ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.5 LI (List Output) Command

This command is used to create a list output of setting conditions on the chart paper.

① Format



② Terminator: CR/LF

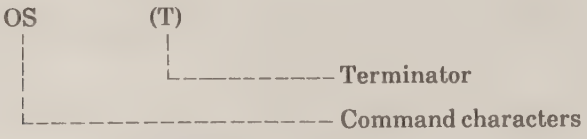
③ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.6 OS (Output Status) Command

This command is used to read the output status signals. When this command is received, the internal conditions of the WR3600 are output as the status.

① Format



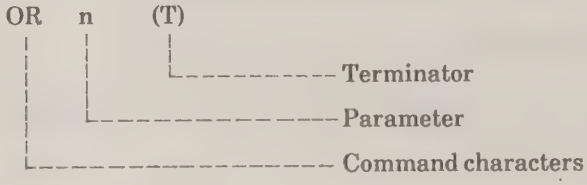
② Terminator: CR/LF

③ Refer to Output Data Format 4 for the data contents.

3.10.7 OR (Output Report) Command

This command is used to read part of a menu or amplifier setting conditions.

① Format



② Parameter

n=1: Outputs the menu setting conditions.

n=2: Outputs amplifier conditions 1.

n=3: Outputs amplifier conditions 2.

③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.8 OI (Output Identify) Command

This command is used to cause the WR3600 to output "WR-3600 CR/LF."

① Format

③ Terminator: CR/LF

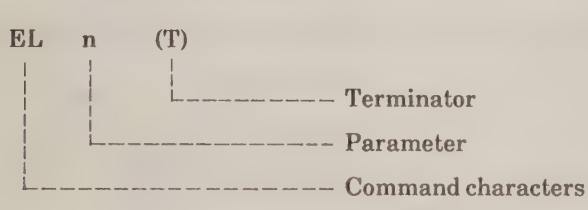
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.9 EL (Event Marker Left) Command

This command is used to set the left-side event marker on and off.

① Format



② Parameter

n = 0: Sets the left-side event marker recording line to off.

n = 1: Sets the left-side event marker recording line to on.

③ Terminator: CR/LF

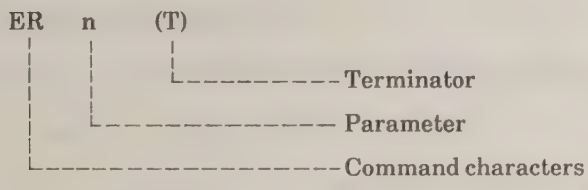
④ Valid conditions: Valid in the addressable mode.

Valid in either the STOP or the START condition.

3.10.10 ER (Event Marker Right) Command

This command is used to set the right-side event marker on and off.

① Format



② Parameter

n = 0: Sets the right-side event marker recording line to off.

n = 1: Sets the right-side event marker recording line to on.

③ Terminator: CR/LF

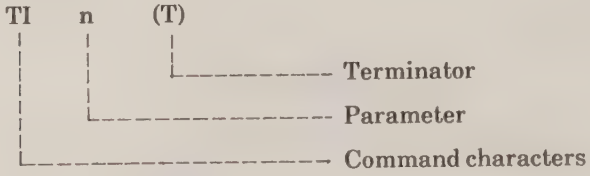
④ Valid conditions: Valid in the addressable mode.

Valid in either the STOP or the START condition.

3.10.11 TI (Time Interval Setting) Command

This command is used to set the timer marker output interval.

① Format



② Parameter

n=0: Timer off

n=1: 0.1-s interval

n=2: 1-s interval

n=3: 10-s interval

n=4: Timer off

n=5: 0.1-min interval

n=6: 1-min interval

n=7: 10-min interval

③ Terminator: CR/LF

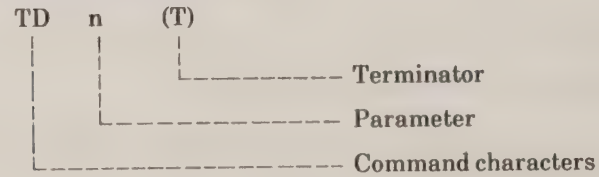
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.12 TD (Time-Code/Internal) Command

This command is used to select either the time code or the internal clock for the master printing of date and time.

① Format



② Parameter

n=0: Selects the internal clock

n=1: Selects the IRIG time code.

③ Terminator: CR/LF

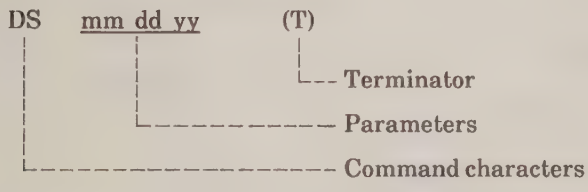
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.13 DS (Date Setting) Command

This command is used to set the date for the internal clock of the WR3600.

① Format



② Parameters

mm: month (01 to 12)

dd: day (01 to 31)

yy: year (00 to 99)

③ Terminator: CR/LF

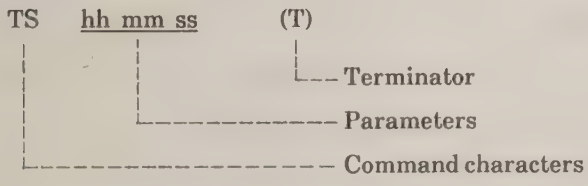
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.14 TS (Time Setting) Command

This command is used to set the time for the internal clock of the WR3600.

① Format



② Parameters

hh: hour (00 to 23)

mm: minute (00 to 59)

ss: second (00 to 59)

③ Terminator: CR/LF

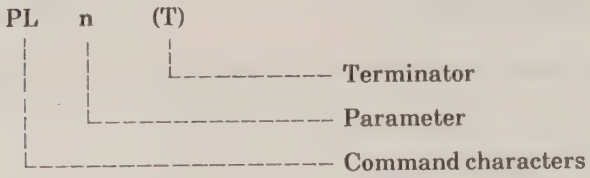
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.15 PL (Print Repeat Length) Command

This command is used to set the interval for master print repetition.

① Format



② Parameter

n=0: No printing

n=1: Print on every page.

n=2: 100-mm interval

n=3: 200-mm interval

n=4: 300-mm interval

n=5: 400-mm interval

n=6: 500-mm interval

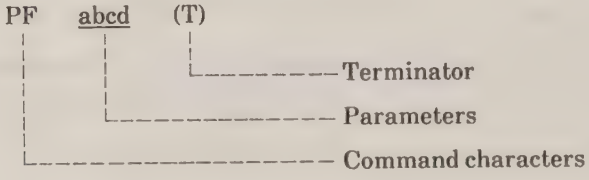
③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.16 PF (Print Format) Command

① Format



② Parameters

a=0: Do not print date in master print.

a=1: Print date in master print.

b=0: Do not print time in master print.

b=1: Print time in master print.

c=0: Do not print speed in master print.

c=1: Print speed in master print.

d=0: Do not print time scale in master print.

d = 1: Print time scale in master print.

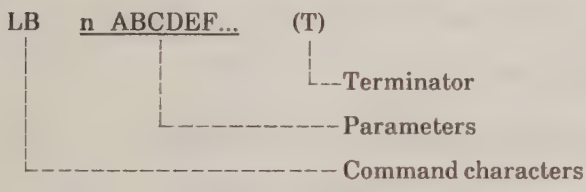
③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.17 LB (Label Print) Command

① Format



② Parameters

n: Channel number for printing (1 to 8)

ABCDEF: ASCII string of up to 128 characters

③ Terminator: CR/LF

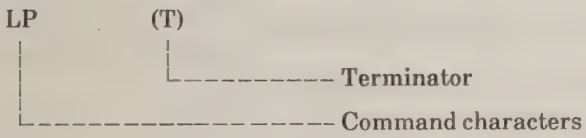
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.18 LP (Label Print) Command

This command is used to enable output of the character string set up using the LB command at the interval set up using the PL command. If this is done, text printing is not possible.

① Format



② Terminator: CR/LF

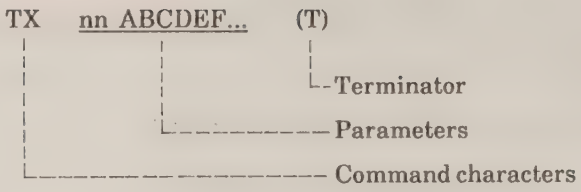
③ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.19 TX (Text Print) Command

This command is used to input text of 80 columns by 40 lines, text being input by line and output by the XP command.

① Format



② Parameters

nn: No. of lines to be printed (01 to 40)

ABCDEF: ASCII character string of up to 80 characters

③ Terminator: CR/LF

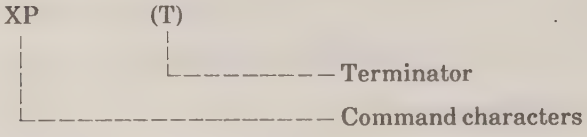
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.20 XP (Text Print Start) Command

This command is used to enable output onto the chart paper of the character string specified using the TX command at the interval specified by the PL command.

① Format



② Terminator: CR/LF

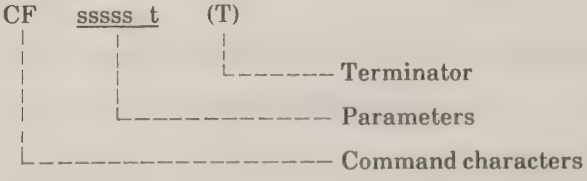
③ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.21 CF (Chart Feed Speed Setting) Command

This command is used to set the chart feed speed.

① Format



② Parameters

sssss: 0.001 to 200.0, and 500.0 mm

t="S": /s

t="M": /min

③ Terminator: CR/LF

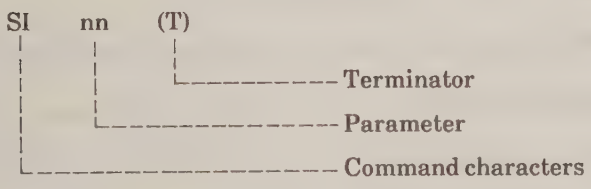
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.22 SI (Sampling Interval Time Setting) Command

This command is used to set the interval time for sampling analog signals in the memory mode.

① Format



② Parameter

nn=00: 10 μs

nn=01: 20 μs

nn=02: 50 μs

nn=03: 100 μs

nn=04: 200 μs

nn=05: 500 μs

nn=06: 1 ms

nn=07: 2 ms

nn=08: 5 ms

nn=09: 10 ms

nn=10: 20 ms

nn=11: 50 ms

nn=12: 100 ms

nn=13: 200 ms

nn=14: 500 ms

nn=15: External

③ Terminator: CR/LF

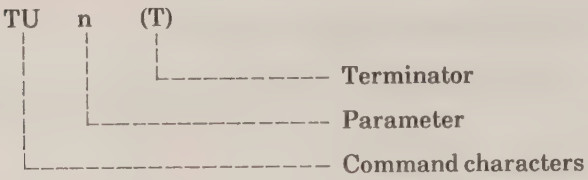
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.23 TU (Trigger Source) Command

This command is used to set the source for the trigger used in the memory mode and in the run-time and run-length settings.

① Format



② Parameter

n=0: Manual triggering

n=1: Internal triggering

n=2: External triggering

③ Terminator: CR/LF

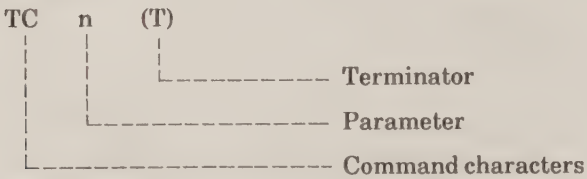
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.24 TC (Trigger Channel Setting) Command

This command is used to set the channel from which the trigger is to be taken for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n: Selected trigger channel

③ Terminator: CR/LF

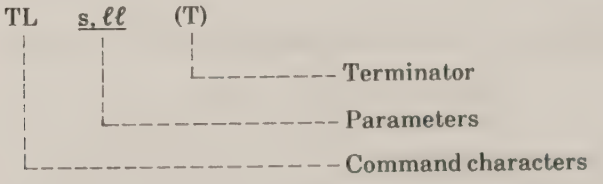
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.25 TL (Trigger Level Setting) Command

This command is used to set the trigger level for the memory mode and the run-time and run-length settings.

① Format



② Parameters

s: Polarity

ℓℓ: Level (00 to 50)

③ Terminator: CR/LF

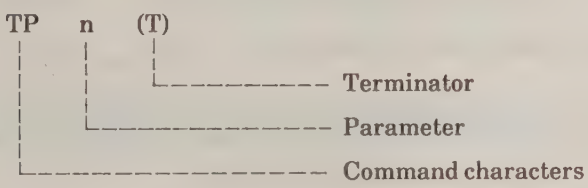
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.26 TP (Trigger Slope Setting) Command

This command is used to set the trigger slope for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n=0: Rising edge

n=1: Falling edge

③ Terminator: CR/LF

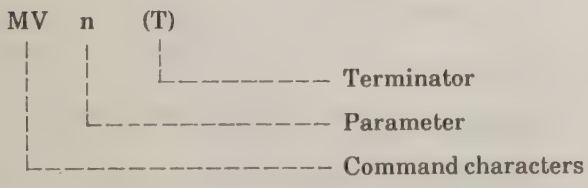
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.27 MV (Memory Volume) Command

This command is used to set the memory volume (capacity) for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n=0: 0.25 Kword

n=1: 0.5 Kword

n=2: 1 Kword

n=3: 2 Kwords

n=4: 4 Kwords

n=5: 8 Kwords

n=6: 16 Kwords

n=7: 32 Kwords

③ Terminator: CR/LF

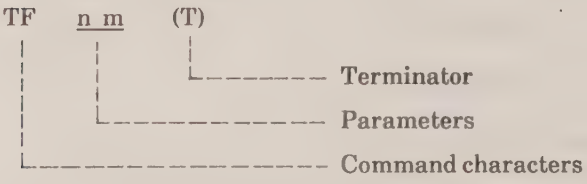
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.28 TF (Trigger Function Setting) Command

This command is used to set the trigger function (pre-, post- or normal triggering) for the memory mode and run-time and run-length settings and to set the offset value.

① Format



② Parameters

n=0: Normal triggering

n=1: Pre-triggering

n=2: Post-triggering

m=0: 0% offset

m=1: 12.5% offset

m=2: 25% offset

m=3: 50% offset

m=4: 100% offset

③ Terminator: CR/LF

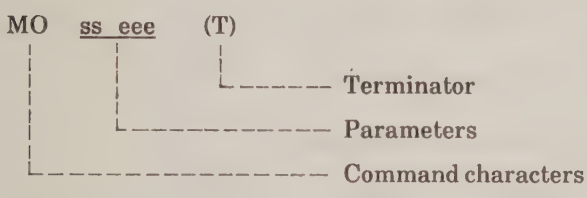
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.29 MO (Memory Output Area) Command

This command is used to set the memory recording output range for the memory mode and the run-time and run-length settings.

① Format



② Parameters

ss = 0: Memory output starting % (00 to 99)

eee = 0: Memory output ending % (001 to 100)

③ Terminator: CR/LF

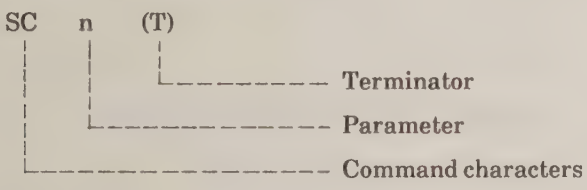
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.30 SC (Scaling Factor) Command

This command is used to set the memory recording output time-axis scaling for the memory mode and the run-time and run-length settings.

① Format



② Parameter

n = 0:	1/1	n = 1:	1/2
n = 2:	1/4	n = 3:	1/8

③ Terminator: CR/LF

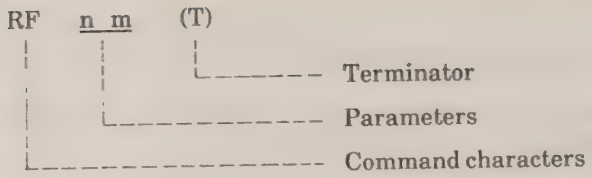
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.31 RF (Recording Format) Command

This command is used to select Y-T and X-Y waveform recording and to enable or disable the menu list.

① Format



② Parameters

n=0: Y-T format selected

n=1: X-Y format selected

m=0: No menu list printout

m=1: Menu list printout

③ Terminator: CR/LF

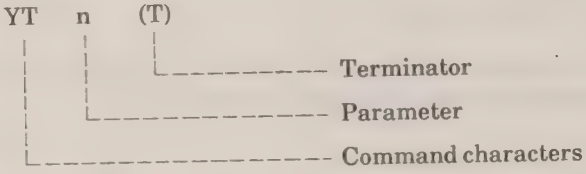
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.32 YT (Y-T Format) Command

This command is used to select the Y-T recording width as single, double, or wide.

① Format



② Parameter

n=0: Single

n=1: Double

n=2: Wide

③ Terminator: CR/LF

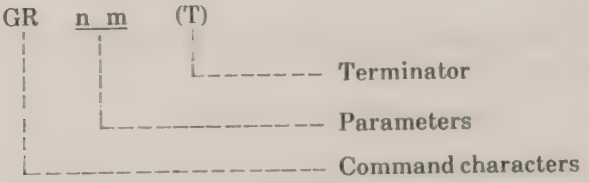
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.33 GR (Grid Type) Command

This command is used to set the type of grid and existence or non-existence of fine grid marks for the Y-T recording mode.

① Format



② Parameters

n=0: Grid off

n=1: 10 × 10 mm

n=2: 5 × 5 mm

n=3: 5 × 4 mm

m=0: No fine grid

m=1: Fine grid

③ Terminator: CR/LF

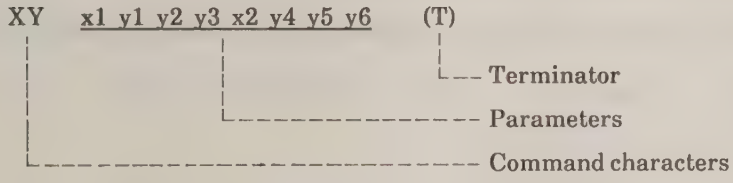
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.34 XY (X-Y Format) Command

This command is used to set the correspondence of channels to various axes for X-Y mode recording.

① Format



② Parameters

x1: Upper X-axis channel number (1 to 4)

y1: Upper y1-axis channel number (1 to 4)

y2: Upper y2-axis channel number (1 to 4)

y3: Upper y3-axis channel number (1 to 4)

x2: Lower X-axis channel number (5 to 8)

y4: Lower y1-axis channel number (5 to 8)

y5: Lower y2-axis channel number (5 to 8)

y6: Lower y3-axis channel number (5 to 8)

③ Terminator: CR/LF

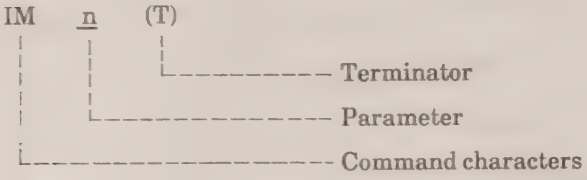
④ Valid conditions: Valid in the addressable mode.

Valid in the STOP condition.

3.10.35 IM (Interrupt Mask)Command

This command is used to enable and disable output of logging data in the talk-only mode.

① Format



② Parameters

n=0: Inhibit generation of an interrupt signal from the WR3600

n=1: Enable generation of an interrupt signal from the WR3600

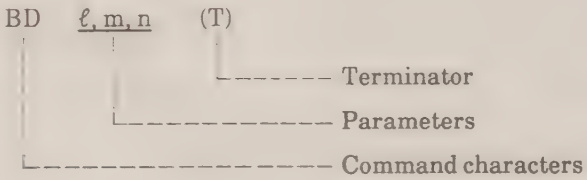
③ Terminator: CR/LF

④ Valid conditions: Valid only in the addressable mode.

3.10.36 BD (Output Binary Data) Command

This command is used to read out data stored in memory in binary format.

① Format



② Parameters

ℓ: Channel number (1 to 8)

m: Data starting point (0 to 32767)

n: Number of data (1 to 32768)

,: The comma between parameters can be replaced by a space.

③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode.

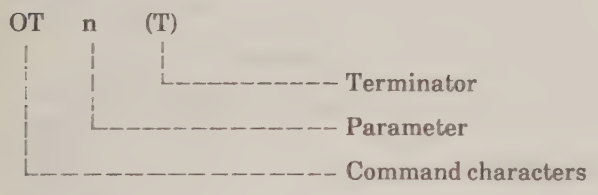
Valid in the STOP condition.

Since binary transfer is performed, the EOI (end or identify) is used as the terminator for data reception.

3.10.37 OT (Output Interval Setting) Command

This command is used to set the recording interval for the direct logging mode.

① Format



② Parameter

n=0:	1 s	n=1:	10 s
n=2:	1 min	n=3:	10 min

③ Terminator: CR/LF

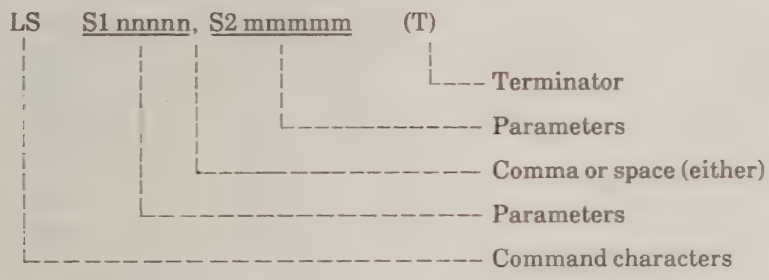
④ Valid conditions: GPIB valid in the addressable mode.

Valid in the STOP condition.

3.10.38 LS (Logging Scale Factor Setting) Command

This command is used to set the recording interval for the direct logging mode.

① Format



② Parameters

n: Low-side full scale (−99999 to +99998)

m: High-side full scale (−99998 to +99999)

Commas can be replaced by spaces to separate parameters

③ Terminator: CR/LF

④ Valid conditions: Valid in the addressable mode

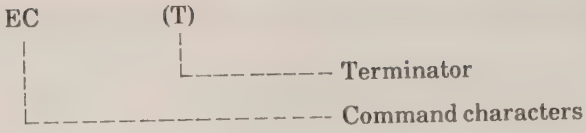
Valid in the STOP condition.

- The comma between parameters can be replaced by a space.

3.10.39 EC (Error Clear)

This command is used to clear the error flag output by the OS command.

① Format



② Terminator: CR/LF

③ Valid conditions: Valid only in the addressable mode.

3.11 Validity of Commands in Various Operating Modes

WR3600 Interface Command (1/2)			Direct YT		Direct XY		Direct Logging		Memory Save		Memory Output	
Item	Com-mand	Function	Start	Stop	Start	Stop	Start	Stop	Start	Stop	Start	Stop
Initialization	IN	INITIALIZE	○	○	○	○	○	○	○	○	○	○
	MD	MODE SET	×	○	×	○	×	○	×	○	×	○
	TG0	RECORD START	×	○	×	○	×	○	○	○	×	○
	TG1	RECORD STOP	○	×	○	×	○	×	○	×	○	×
	FF	FORM FEED	×	○	×	○	×	○	×	○	×	○
	LI	LIST OUT	×	○	×	○	×	○	×	○	×	○
Status output	OS	OUTPUT STATUS	○	○	○	○	○	○	○	○	○	○
	OR1	OUTPUT REPORT 1	×	○	×	○	×	○	×	○	×	○
	OR2	OUTPUT REPORT 2	×	○	×	○	×	○	×	○	×	○
	OR3	OUTPUT REPORT 3	×	○	×	○	×	○	×	○	×	○
	OI	OUTPUT IDENTITY	×	○	×	○	×	○	×	○	×	○
Event	EL	EVENT LEFT ON/OFF	○	○	×	×	×	×	×	×	×	×
	ER	EVENT RIGHT ON/OFF	○	○	×	×	×	×	×	×	×	×
Timer	TI	TIME INTERVAL SET	×	○	×	×	×	×	×	×	×	×
Clock	TD	TIME CODE/ INTERNAL	×	○	×	×	×	×	×	×	×	×
	DS	DATE SET	×	○	×	○	×	○	×	○	×	○
	TS	TIME SET	×	○	×	○	×	○	×	○	×	○
Printing format	PL	PRINT REPEAT LENGTH	×	○	×	×	×	×	×	×	×	×
	PF	PRINT FORMAT	×	○	×	×	×	×	×	×	×	×
	LB	PRINT LABEL	×	○	×	×	×	×	×	×	×	×
	LP	LABEL PRINT START	×	○	×	×	×	×	×	×	×	×

WR3600 Interface Command (2/2)			Direct YT		Direct XY		Direct Logging		Memory Save		Memory Output	
Item	Command	Function	Start	Stop	Start	Stop	Start	Stop	Start	Stop	Start	Stop
Printing format	TX	PRINT TEXT	×	○	×	×	×	×	×	×	×	×
	XP	TEXT PRINT START	×	○	×	×	×	×	×	×	×	×
Chart control	CF	CHART SPEED VI	×	○	×	×	×	×	×	×	×	×
Memory mode	SI	SAMPLING INTERVAL TIME	×	×	×	×	×	×	×	○	×	×
	TU	TRIGGER SOURCE	×	×	×	×	×	×	×	○	×	×
	TC	TRIGGER CHANNEL	×	×	×	×	×	×	×	○	×	×
	TL	TRIGGER LEVEL	×	×	×	×	×	×	×	○	×	×
	TP	TRIGGER SLOPE	×	×	×	×	×	×	×	○	×	×
	MV	MEMORY VOLUME	×	×	×	×	×	×	×	○	×	×
	TF	TRIGGER FUNCTION	×	×	×	×	×	×	×	○	×	×
	MO	MEMORY OUTPUT	×	×	×	×	×	×	×	×	×	○
	SC	SCALING FACTOR	×	×	×	×	×	×	×	○	×	○
Recording format	RF	RECORD FORMAT	×	○	×	○	×	×	×	○	×	○
	YT	Y-T FORMAT	×	○	×	×	×	×	×	○	×	○
	GR	GRID TYPE	×	○	×	×	×	×	×	○	×	○
	XY	X-Y FORMAT	×	×	×	○	×	×	×	○	×	○
Data output	BD	BINARY DATA OUT	×	×	×	×	×	×	×	○	×	○
	IM	INTERRUPT MASK	×	×	×	×	○	○	×	×	×	×
Logging mode	OT	OUTPUT INTERVAL	×	×	×	×	×	○	×	×	×	×
	LS	LOGGING SCALE FACTOR	×	×	×	×	×	○	×	×	×	×
Other	EC	ERROR CLEAR	○	○	○	○	○	○	○	○	○	○

3.12 Typical Command Usage Examples (GPIB)

The WR3600 is provided with a set of interface commands used for data transfer and summarized in the interface command table. This section will provide examples of using the GPIB interface with a PC-9801 Personal Computer used to control the recorder, giving typical examples of common usage.

3.12.1 Panel Key Status Transfer Command (OR1 Command)

This command is used to output the panel setting conditions to the computer.

(a) Program Example

```
10  '
20  'WR3600 SAMPLE PROGRAM for
30  'ADDRESSABLE MODE
40  '
50  ISET IFC : ISET REN
60  CMD DELIM=1
70  PRINT @1; "OR1"
80  LINE INPUT @1; A$
90  PRINT A$
100 END
```

Fig. 3-12 OR1 Command Program Example

The above program is described below.

50: Clear the interface and enable the remote condition.

60: Set the PC-9801 Delimiter to CR.

70: Send the OR1 command.

80: Set A$ to the received data.

90: Display the contents of A$ on the computer screen

(b) Operations Required for Transfer

The operations required for transfer are as follows.

① Load the program shown in Fig. 3-12 into the computer.

② Verify that the GPIB interface panel switches are set to 11100001 from the bottom. (EOI Disabled, Addressable Mode, Address set to 1)

③ Press the STOP key on the WR3600 to enable the hold condition.

④ Press the CONTROL key on the WR3600 to enable the REMOTE (I/F) mode.

⑤ Run the program on the PC-9801.

The above operations execute the program shown in Fig. 3-12, causing data to be displayed on the CRT screen.

(c) Transferred Data Contents

The transferred data format is shown in Fig. 3-13.

Digit Sequence	Character	Description
1	M	Memory mode
2	0	Memory size 0.25 Kwords
3	2	
4	5	
5	1	Sampling interval — 10 μs
6	U	Sampling units μs — 10 μs
7	1	Second power of 10 — 10 μs
8	1	Trigger channel 1
9	M	Manual trigger
10	R	Trigger slope
11	+	
12	1	Offset size +100%
13	0	
14	0	
15	N	Normal triggering

Fig. 3-13 Transferred Data Contents (OR1)

3.12.2 Amplifier Setting Condition Transfer (OR2 Command)

This command is used to read out the amplifier settings.

(a) Program Example

```
10   '
20   'WR3600 SAMPLE PROGRAM for
30   'ADDRESSABLE MODE
40   '
50   ISET IFC : ISET REN
60   CMD DELIM=1
70   PRINT @1; "OR2"
75   FOR I=1 to 8
80   LINE INPUT @1; A$
90   PRINT A$
95   NEXT 1
100  END
```

Fig. 3-14 OR2 Command Program Example

The major lines of the program in Fig. 3-14 are described below.

50: Clear the interface and enable the remote condition.

60: Set the PC-9801 Delimiter to CR.

70: Send the OR2 command.

75 to 95: Transfer data 4 times from the WR3600 and display it in 4 lines on the PC-9801 screen.

(b) Operations Required for Transfer

When operation ① through ④ of (b) in the previous section are performed, the data shown in Fig. 3-15 is displayed on the CRT of the PC-9801.

(c) Transfer of Data Contents

The transferred data format is shown in Fig. 3-16.

```
1S 0001E3
2S 0500E0
3S 0500E0
4S 0500E0
5S 0500E0
6S 0500E0
7S 0500E0
8S 0500E0
```

Fig. 3-15 Transferred Data Display

Digit Sequence	Character	Description
1	1	Channel No. 1
2	S	MEAS/OFF Switch set to MEAS
3		Space
4	0	Range mantissa
5	0	
6	0	
7	1	
8	E	
9	3	Range 10 exponent

Fig. 3-16 Transferred Data Contents (OR2 Uppermost Line)

3.12.3 Logging Mode Transfer (IM, TG, and GET Commands)

In the logging mode, the WR3600 START key is pressed and data captured; the data being displayed and recorded are transferred to a computer. Because of this arrangement, the IM1 command must be sent first to disable any unexpected interrupts, after which the TG0 command is used to start the WR3600. Then , the multi-line message can be used to send the talk address and the GET command, after which data is captured the required number of times and finally the STOP key is pressed.

(a) Program Example

```
10   'WR3600 Sample
20   'Program for
30   'ADDRESSABLE
40   'MODE
50   ISET IFC : ISET REN
60   CMD DELIM=1 : B=0
70   SRQ ON
80   PRINT @1; "IM1" : SET INTERRUPT
     MASK
90   PRINT @1; "TG0" : WR3600 START
95   FOR T=0 TO 2500 : NEXT T : INITIAL WAIT
100  ON SRQ GOSUB 230
110  FOR N=0 TO 100
120  IF B=65 THEN 130 ELSE SRQ ON : GO TO 120
130  FOR J=0 TO 100 : NEXT J : DUMMY WAIT
```

```
140  WBYTE &H21, &H8; : GET COMMAND SEND TO WR3600
150  FOR I=0 TO 8
160  LINE INPUT @1; A$
170  PRINT A$
180  NEXT I
190  B=0 : ;SRQ ON
200  NEXT N
210  PRINT @1; "TG1"
220  END
230  SRQ OFF : POLL 1, B : SRQ ON
240  IF B<64 THEN RETURN
250  PRINT "SRQ ANS. NO.
260  RETURN
```

Fig. 3-17 Logging Mode Program Example

The major lines of the above program are described below.

50: Clear the interface and enable the remote mode.

60: Set the PC-9801 delimiter to CR and set register B to 0.

70: Set the service request to on.

80: Set the IM1 command into the WR3600 to enable the interrupt signal.

90: Send the TG0 command to start the WR3600.

100: If a service request occurs, jump to line 230 and execute the subroutine of lines 230 through 360.

110: Set loop counter N (N=0 to 100)

120: If B=65, read in data. If not, loop on this line.

130: Dummy timer

140: Send GET command to WR3600

150: Loop counter I setting (I=0 to 8)

160: Set A$ to the data received.

170: Display A$ on the CRT screen.

180: Next I

190: Reset B to 0 to enable a service request.

200 Next N

210: Send the TG1 command to stop the WR3600

220: End

230: Inhibit the service request, execute polling of the WR3600, substitute the status byte into B and enable service request.

240: If B is less than 64, return to line 120.

250: If B is 64 or greater, display the value of B on the CRT screen.

260: Return to line 120

Note

In the above program, the IM1 and GET commands are required for reasons described in the data transfer protocol. Refer to that section.

(b) **Operations Required for Transfer**

The WR3600 is set into the logging mode and , after pressing the STOP key the program at the PC-9801 is run. At this point, the data shown in Fig. 3-18 is displayed sequentially on the CRT screen.

```
7  U.- 0007E-4
8  U.- 0009E-4

01/01'88 00:00:11
1  U.+ 0004E-3
2  U.+ 0000E-0
3  U.- 0014E-4
4  U.+ 0000E-0
5  U.- 0007E-4
6  U.+ 0004E-4
7  U.- 0007E-4
8  U.- 0003E-4

01/01'88 00:00:12
1  U.+ 0000E-0
2  U.+ 0007E-4
3  U.- 0009E-4
4  U.+ 0000E-0
5  U.- 0002E-4
6  U.+ 0007E-4
7  U.- 0004E-4
   U.- 0007E-4
```

Fig. 3-18 Transferred Data Display (Logging Mode)

3.13 Notes on Data Transfer

3.13.1 Logging Mode Time Diagrams

Since data transfer in the logging mode is performed during real-time operation, it is performed using a protocol that differs from data transfer performed in the stopped condition. Also, in this mode, the WR3600 may be set into the talk-only mode with respect to external listen-only devices.

The following describes the internal protocol used for this type of operation.

(a) GPIB Addressable Mode

Fig. 3-19 shows the timing diagram for this type of operation. The WR3600 is placed in the logging mode and the computer program is run. When the TG0 command is executed, (or when the START key is pressed), the data transfer is performed following the protocol shown. (The computer program is shown in Fig. 3-17)

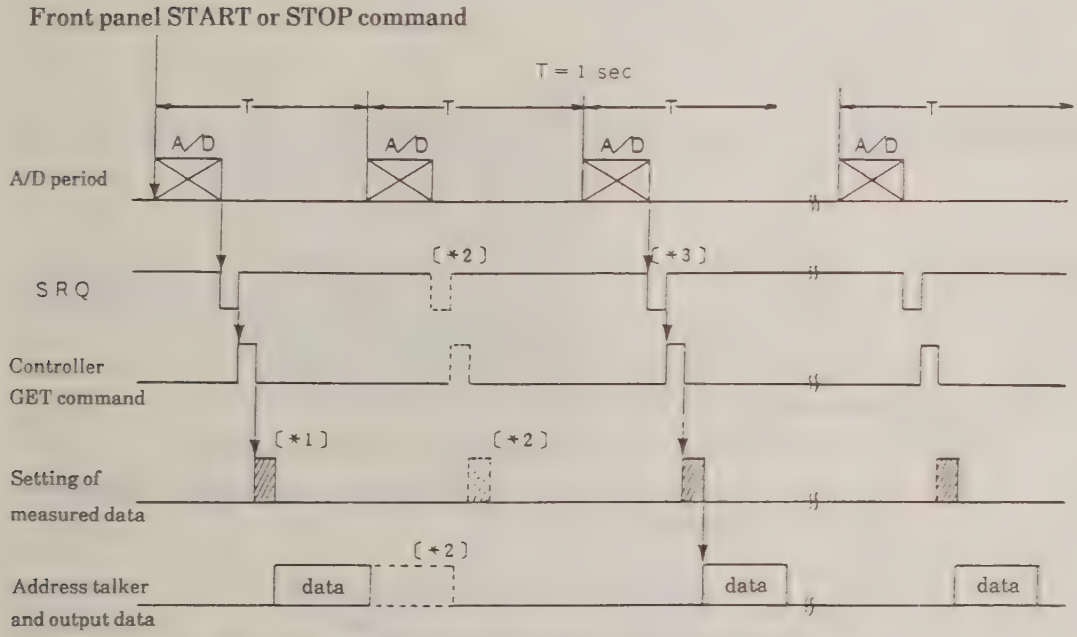


Fig. 3-19 GPIB Addressable Mode Logging Data Transfer

Description of Fig. 3-19

*1 After receiving the controller GET command, measured data values are set into the output buffer.

*2 After setting of measured data values is completed, data output is possible. The recorder is set into the talker mode and data is transferred. When the next A/D period is entered, it is not possible to update data and interrupt the controller. As shown by the dotted line in the figure, this data is frozen.

*3 When the IM1 command has been set, the program should be written so that the status byte is read out every time at the controller.

Description of Fig. 3-20

*1 When the A/D conversion on the measurement channel is completed, the measured data value is set into the output buffer.

*2 When the setting of the data into the buffer register is completed, data output begins. If the next A/D period is entered before data

output has been completed, data will not be output and, as shown by the dotted line in the figure, that data output is skipped.

*3 At the listener start signal, the start operation begins, and at the listener stop signal, the transfer operation is stopped.

(b) Talk Only

The GPIB interface SI switch is set to talk only (position 2 set to on) and logging data is transferred with the timing shown in Fig.3-20.

Interface: GPIB Talk Only Mode
Operating panel or start command

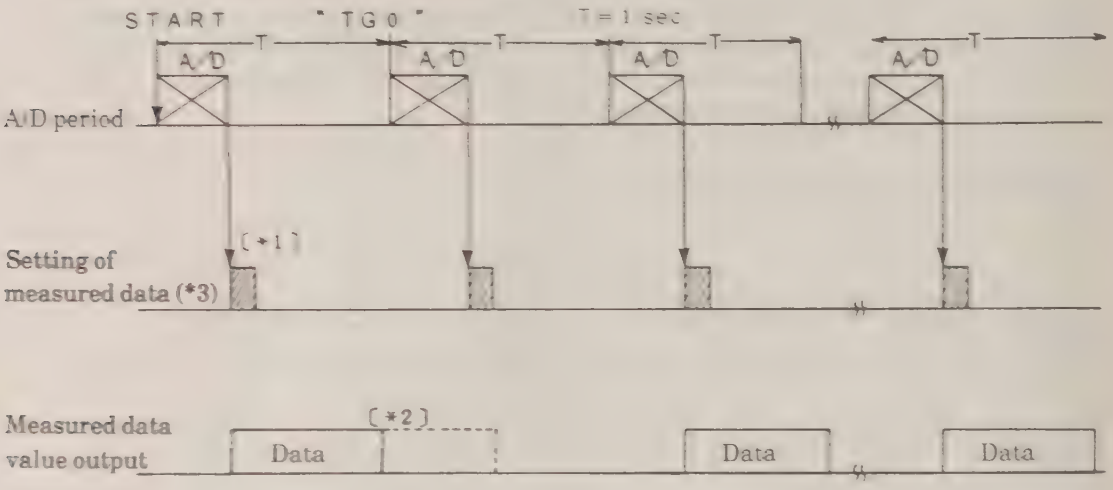


Fig. 3-20 GPIB Talk Only or RS-232C Data Transfer

3.13.2 Interface Specifications and Functions

This is additional information on interface specifications and functions.

1 Signal lines: The pin arrangement of the GPIB connector is given again in Fig. 3-21 in Table form.

Pin No.	Signal Line Name	Pin No.	Signal Line Name
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	NC
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	NC	22	GND
11	ATN	23	GND
12	SHIELD	24	LOGIC GND

Fig. 3-21 GPIB Connector

② GPIB interface functions: The GPIB interface functions of the WR3600 are shown in Fig. 3-22.

③ Data format: All character strings are ASCII code or binary format. All values are expressed in decimal notation (for ASCII format).

④ Electrical characteristics: Input/output signal levels are TTL level with logic levels as follows.

Logic 0 : +4 V min.

Logic 1 : +5 V max.

The input and output circuits are shown in Fig. 3-23

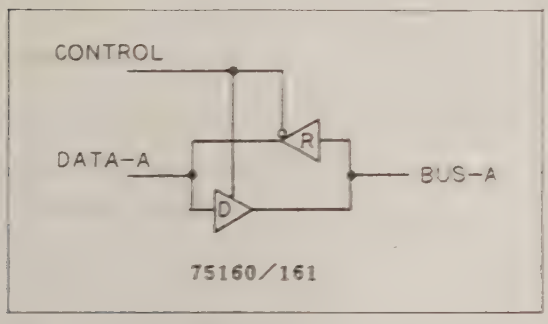


Fig. 3-23 Input/Output Circuit Configurations

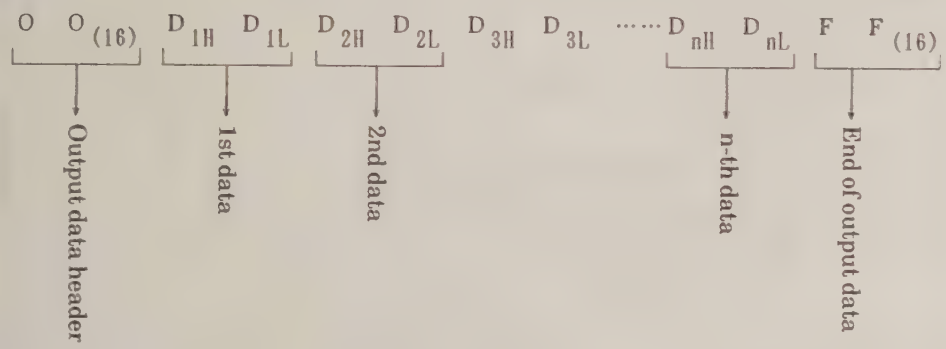
⑤ Signal Name descriptions: The GPIB signal names conform to IEEE-488 standards. These are shown in Fig. 3-24.

AH1	Has acceptor handshake function
SH1	Has send handshake function
T5	Has basic talker function, serial polling, talk-only mode, and talk-cancel function by MLA (My Listen Address)
L4	Has basic listener function and listener - cancel function by MTA (My Talk Address)
SR1	Has service request function
RL0	Has no RL functions
PP0	Has no parallel poll function
DC1	Has device clear functions
DT1	Has device trigger function
C0	Has no controller function

Bus Signal Lines		Description
DIO 1	Data Input/Output 1)	Used for transfer of data and commands
DIO 2	Data Input/Output 2)	
DIO 3	Data Input/Output 3)	
DIO 4	Data Input/Output 4)	
DIO 5	Data Input/Output 5)	
DIO 6	Data Input/Output 6)	
DIO 7	Data Input/Output 7)	
DIO 8	Data Input/Output 8)	
DAV (Data Valid)		Indicates data validity
NFRD (Not Ready for Data)		Ready for reception signal
NDAC (Data Not Accepted)		Reception complete signal
ATN (Attention)		Indicates whether DIO data is an address or a command
IFC (Interface Clear)		Initializes the interface
EOI (End or Identify)		Indicates the last byte of data

Table 3.2 Output Data Format

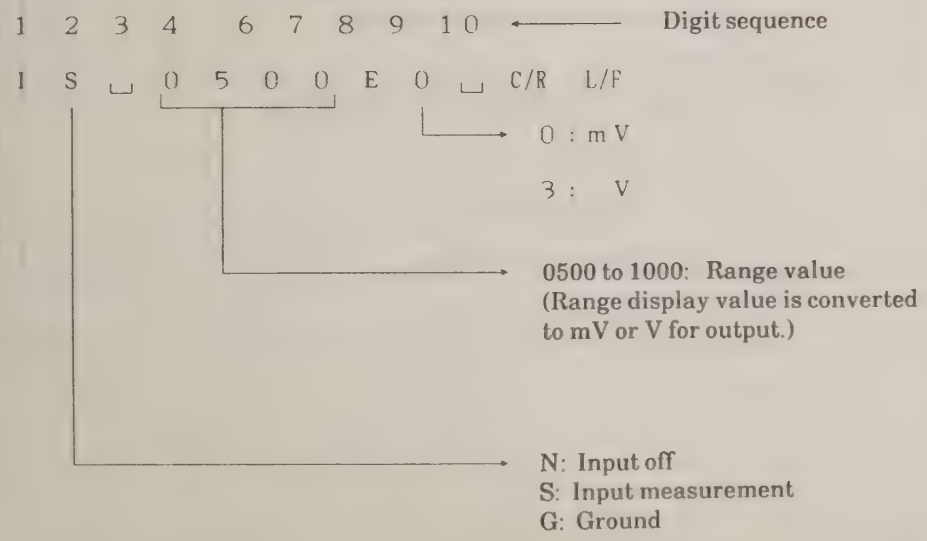
Format 1 (Binary Data)



- D_{nH} is upper byte of data (00 to $0F_{16}$)

  D_{nL} is lower byte of data (00 to $0F_{16}$)
- $D_{nH}D_{nL}$ value example: For the ×10-V range FFF: +10 V
  000: −10 V
- If EOI is valid, EOI is output simultaneously with the last FF_{16}.

Format 2 (Amplifier Setting Conditions-1)


1 2 3 4 6 7 8 9 10 ← Digit sequence
I S ␣ 0 5 0 0 E 0 ␣ C/R L/F
0 : mV
3 : V
0500 to 1000: Range value
(Range display value is converted
to mV or V for output.)
N: Input off
S: Input measurement
G: Ground

Format 3 (Amplifier Setting Conditions-2)

1 2 3 4 5 6 7 8

1 + 25 ␣ ␣ ␣ ␣ C/R L/F

−50% to +50%: Amp position

1 to 8: Channel no.

Format 4 (Status Signals)

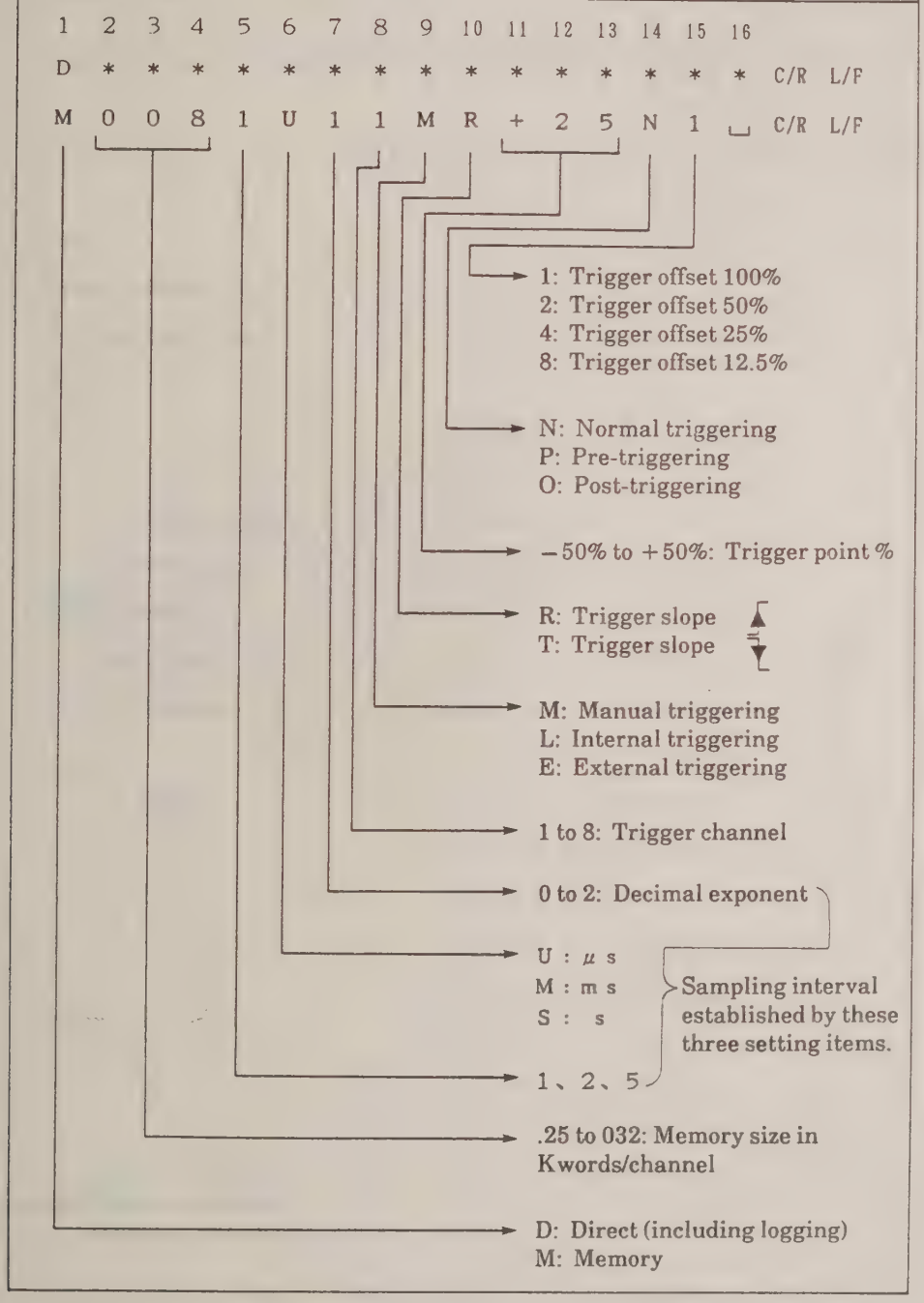
1 2 3 4 5 6

␣ ␣ ␣ ␣ 3 2 C/R L/F

0 to 255: Decimal representation of status byte value

On bit	Value	Contents	Name
1	1		
2	2		
3	4		
4	8		
5	16	Bit set on during measurement or recording	
6	32	Bit set on if any of the following occurs. • Interface error • Command error	ERROR
7	64	On for paper end condition	PAPER END
8	128		

Format 5 (Major Menu Setting Conditions)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
D * * * * * * * * * * * * * * * C/R L/F
M 0 0 8 1 U 1 1 M R + 2 5 N 1 ␣ C/R L/F
1: Trigger offset 100%
2: Trigger offset 50%
4: Trigger offset 25%
8: Trigger offset 12.5%
N: Normal triggering
P: Pre-triggering
O: Post-triggering
−50% to +50%: Trigger point %
R: Trigger slope
T: Trigger slope
M: Manual triggering
L: Internal triggering
E: External triggering
1 to 8: Trigger channel
0 to 2: Decimal exponent
U : μ s
M : m s
S : s
Sampling interval established by these three setting items.
1、2、5
.25 to 032: Memory size in Kwords/channel
D: Direct (including logging)
M: Memory

Format 6 (Logging Mode Output Data)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

01/01'88 00:00:00 C/R L/F

Hour, minute, second

Month, day, year

1 V. + 0004E-3 C/R L/F

Exponent of 10

Voltage mantissa

+.−: Voltage polarity

V: Units (Volts)

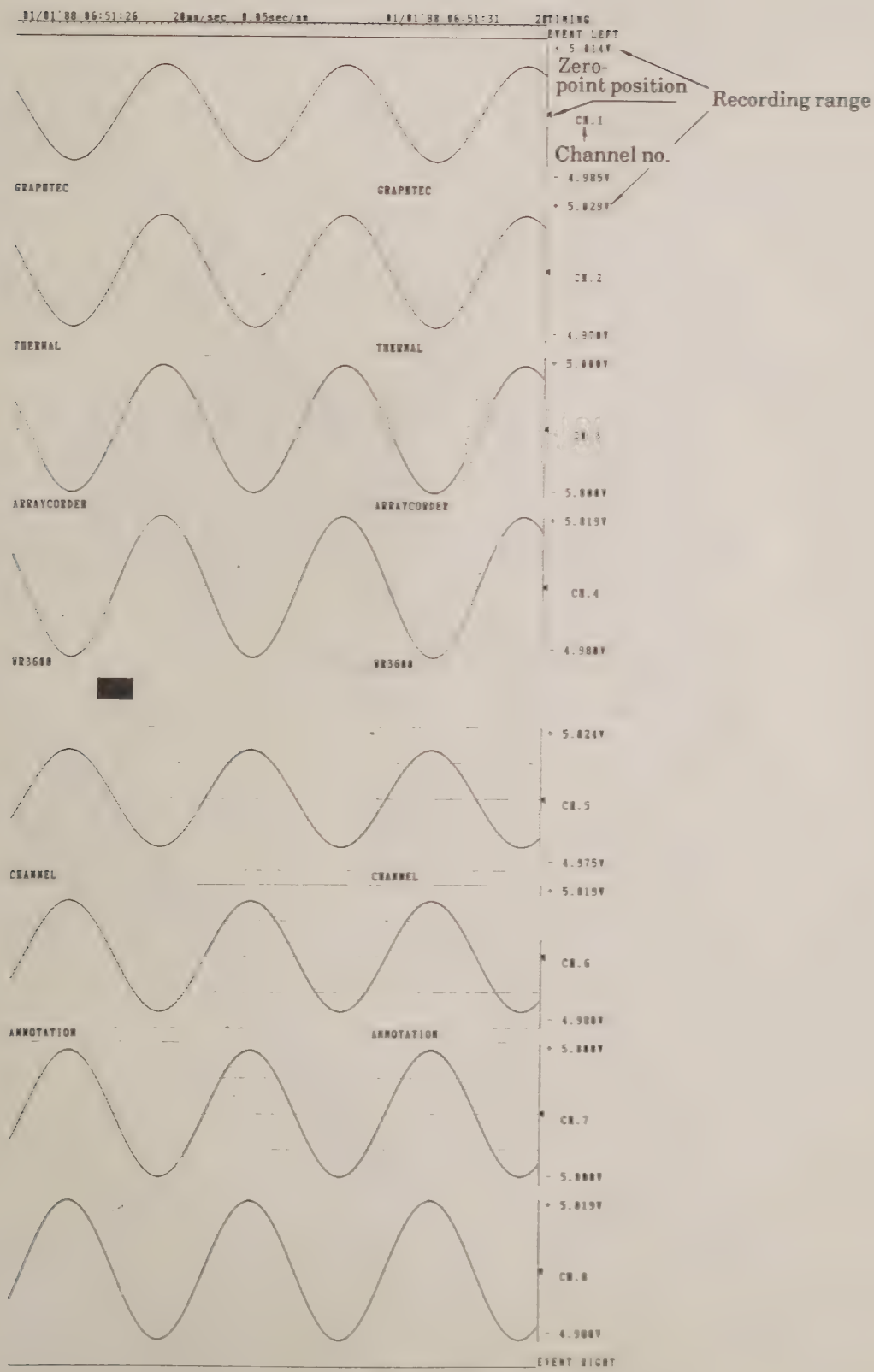
1: Channel (1 to 8)

2 V. + 0008E-3 C/R L/F
3 V. + 0004E-3 C/R L/F
4 V. − 0004E-3 C/R L/F
5 V. − 0008E-3 C/R L/F
6 V. + 0004E-3 C/R L/F
7 V. + 0004E-3 C/R L/F
8 V. + 0008E-3 C/R L/F

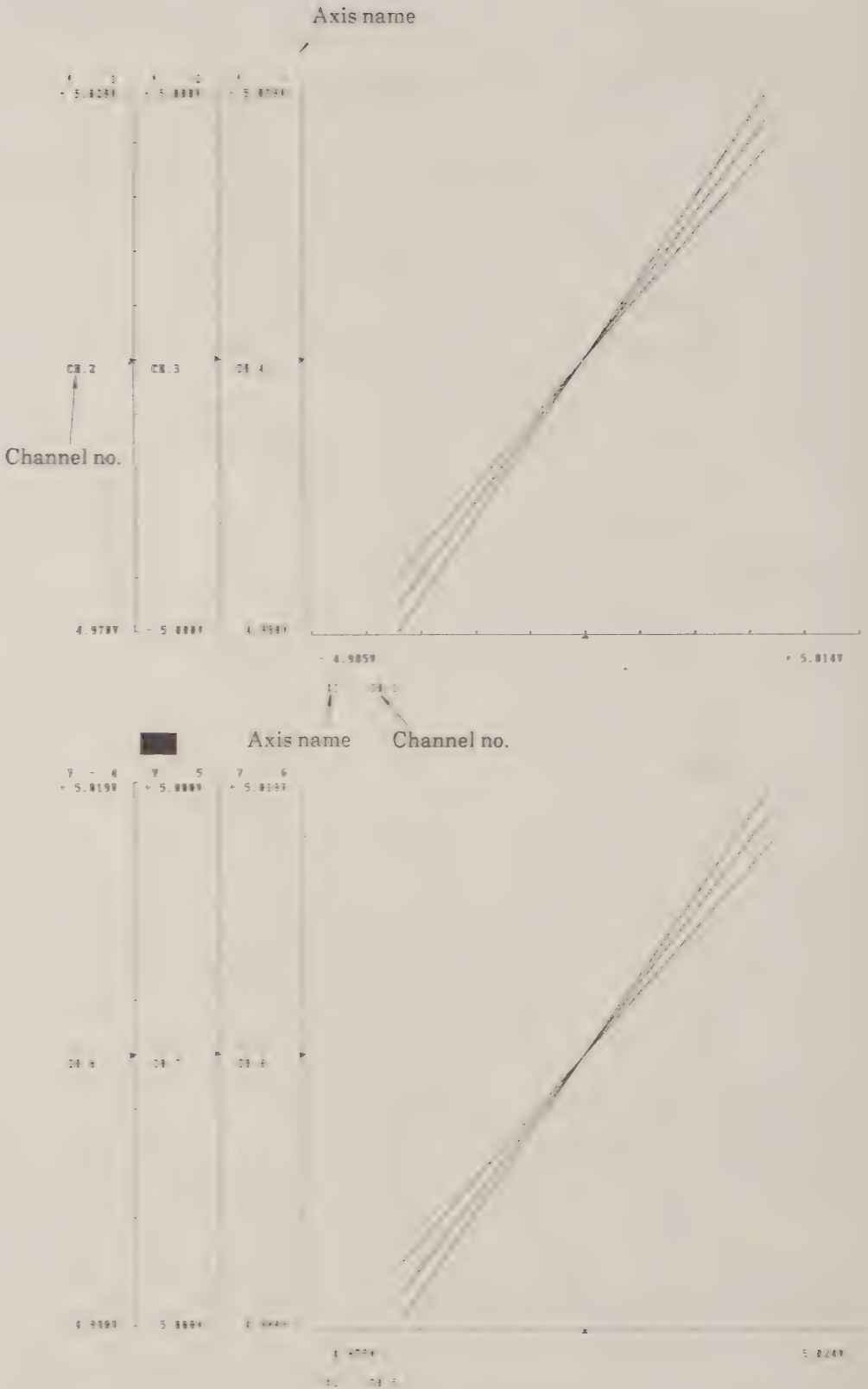
When EOI is valid
EOI is sent simultaneously
with the character.

Recording Example 1

Y-T Recording



Recording Example 2

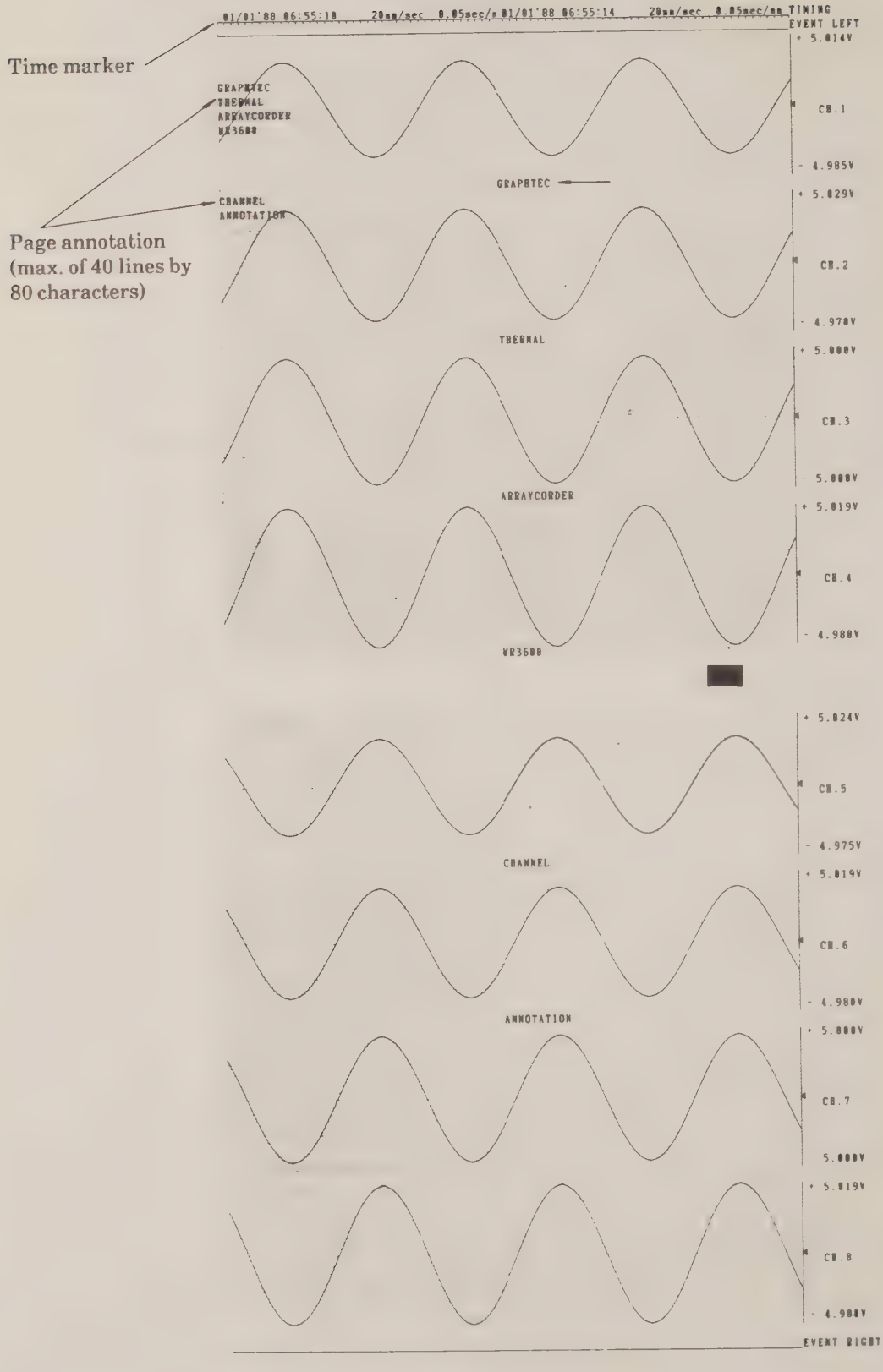


Recording Example 3

Coarse grid

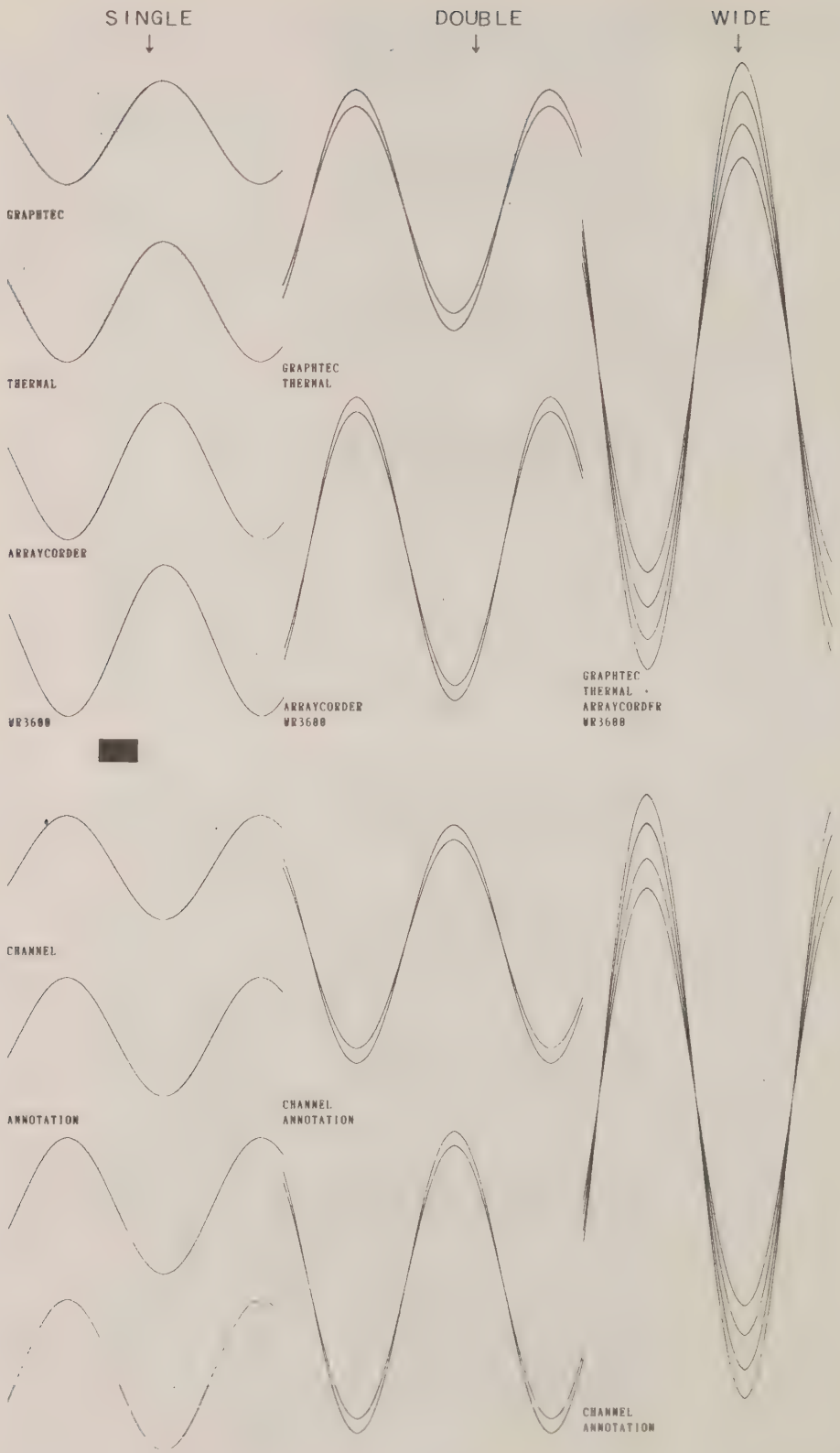
Fine grid

Recording Example 4



Recording Example 5

Recording Example 6



List Recording Example 1

```
DATE   01/01'88

TIME   06:57:47


CONTROL            LOCAL

RECORD  MODE       DIRECT

FORMAT    Y-T     SINGLE

AXIS 1   X1: 1    Y1: 2    Y2: 3    Y3: 4

AXIS 2   X2: 5    Y4: 6    Y5: 7    Y6: 8

CHART     MODE             INTERNAL
          SPEED              10    mm/sec
          DIVID  BY          1/10
        VARIABLE SPEED1     15.00   mm/sec
        VARIABLE SPEED2     75.00   mm/sec
          CHART  TYPE       Z-FOLD
```

PREAMP.

	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
LINE	MEAS	MEAS	MEAS	MEAS	MEAS	MEAS	MEAS	MEAS
RANGE	10V	10V	10V	10V	10V	10V	10V	10V
POL.	+	+	+	+			-	-
POSITION	-00.1%	00.2%	0 %	00.1%	-00.2%	00.1%	0 %	-00.1%

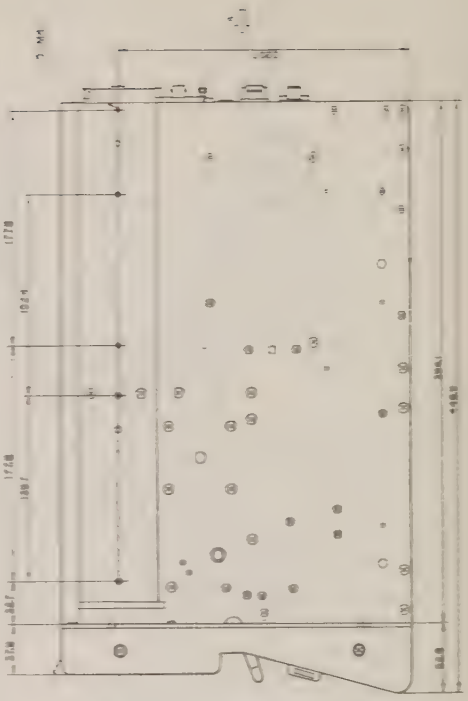
[redacted]

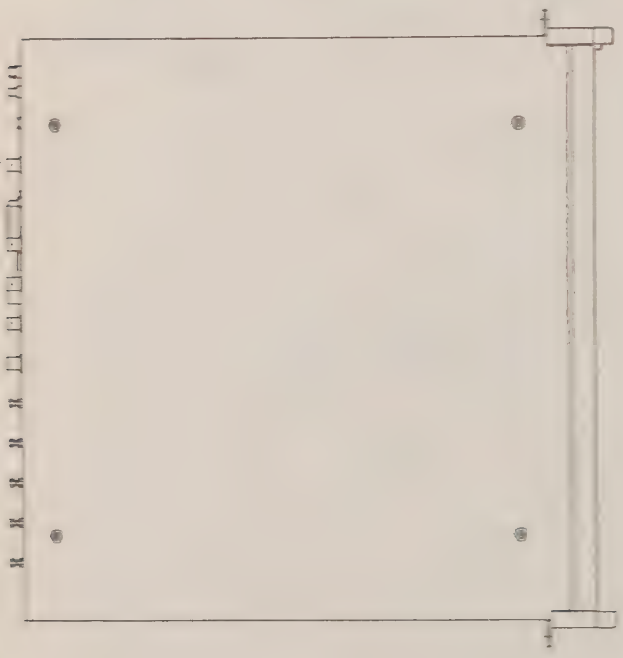
```
TIMING  MARKER   0.1 sec

PRINT    SYS      DATE     TIME      SPEED      TIME_SCALE
        REPEAT     100     mm
```

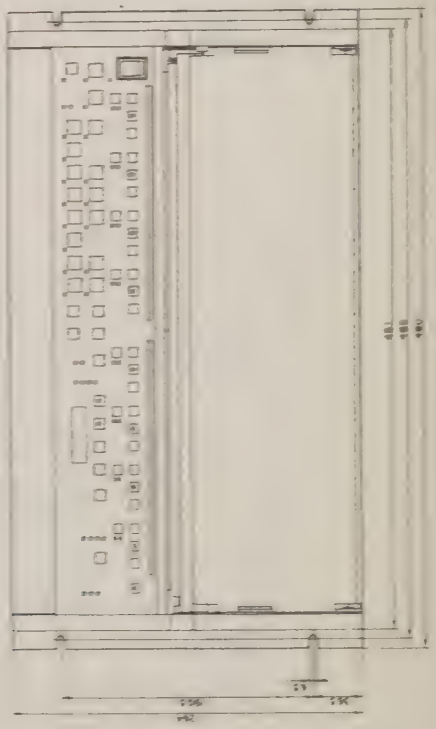
CHANNEL	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
EVENT		-	-					

```
MEMORY   MEMORY   VOLUME     0.25  kwords
          SAMPLE   CLOCK   INTERNAL
        SAMPLING INTERVAL     10      usec
          OUTPUT   AREA    00100%
          START    POINT   00000%
        SCALING    FACTOR    1/1

TRIGGER  TRIGGER   SOURCE   MANUAL
         TRIGGER   LEVEL   +100%
         TRIGGER   SLOPE      ∮
         TRIGGER  FUNCTION  NORMAL

RUN MODE    Normal


RUN TIME    Continue
```

4. OUTER VIEWS







INSPECTION CERTIFICATION

This product was manufactured under a strict program of quality control and has passed severe inspections. Inpsections were performed at normal room temperature and humidity after the unit's circuitry was allowed to stabilize.

Inspector: _____

The specifications in this manual are subject to change without prior notice.

February 20, 1989 2nd edition

Graphtec Corporation

www.manualsplus.com
1035702

WESTERN GRAPHTEC

WESTERN GRAPHTEC, INC.
11 Vanderbilt
Irvine, CA 92718-2067
In California (714) 770-6010 / (800) 624-8396
Outside California (800) 854-8385

Part .No. 036009060